THE CARE OF THE PATIENT IN SURGERY

INCLUDING TECHNIQUES

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By

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PREFACE TO THIRD EDITION

The second edition of *Operating Room Technique* has been used as a text for operating room nursing and management for the past nine years. Operating room nurses, clinical instructors, nursing students, hospital and nursing administrators, and physicians have evaluated the content and have made suggestions for this completely revised edition, *The Care of the Patient in Surgery, Including Techniques.*

Much of the value of this book rests on the knowledge gained from predecessors whose ideas have appeared in recognized medical and nursing journals and texts and on the ideas and practice of outstanding practitioners and specialists in related fields who willingly cooperated in the difficult and time-consuming task of preparing this manuscript.

This book was written primarily to assist the nurse and others who accept direct and indirect responsibilities for the care of the patient undergoing surgery.

To treat the patient in surgery, the most competent physician needs capable, kindly medical and technical assistants, a safe environment, and efficient appropriate tools Due to the broadening scope and increasing complexities of surgery and of scientific and technical discoveries, as well as the shortage of professional personnel, the professional nurse must now be prepared to accept new responsibilities as a member of the hospital health team. The members of the surgical team must have an understanding of the patient, knowledge of the disease and the anatomic, physiologic, and emotional factors involved, an awareness of the objectives and plan of treatment, and technical skill in applying the principles of medical asepsis.

With these responsibilities in mind, the author has presented herein pertinent information and ideas of practice that will interest, inform, and stimulate further exploration.

The first five chapters present facts, ideas, illustrations, and references on modern operating facilities, safety measures, and suggested procedures for ensuring a safe, comfortable environment and prompt wound healing. Principles and suggested steps of common procedures are presented and illustrated as a guide for administrators, teachers, and nursing students.

The content, illustrations, and references of the remaining twelve chapters are arranged to give information and awareness of the various services, such as

neurosurgery, nose and throat, bronchoesophagology, thoracic, cardiac, vascular, abdominal, gastrointestinal, gynecologic, genitourinary, and orthopedic surgery. These chapters are so arranged to permit the reader to use them in whatever sequence seems desirable. The information is intended to orient the nursing personnel to the elements of specific types of operations which have been proved successful. Each chapter contains a summary of the anatomy and physiology involved, major considerations, objectives, plan of treatment, and techniques and tools for specific operations. The selective operations and references are by no means intended to be all-inclusive but rather to stimulate exploration.

The techniques and procedures described are not necessarily those found in all operating rooms and they may need certain adaptation to meet the particular patient's needs. The techniques and procedures included are safe and therapeutically effective and conserve human and material resources.

There is need today for professional operating room nurses who have a rich background in the fundamental nursing sciences and who have vision and a desire to teach nursing personnel the art of operating room nursing and good administration. Modern professional nurses should ask themselves the following questions: What do the patient, the surgeon, and my co-workers expect of me? Do I fulfill their expectations and meet my responsibilities as a professional nurse? It is believed that this book can assist many nurses and others who are continually improving the kind of care given to the patients in surgery.

New York, N. Y. EDYTHE LOUISE ALEXANDER

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PREFACE TO FIRST EDITION

The purpose in perfecting every detail of surgical technique is to ensure that the patients under treatment may have every chance to overcome the disease or injury with which they are afflicted. From the moment an operation is decided upon, every phase of the handling of the patient, every detail, no matter how small, becomes of greatest importance.

Many individuals in the hospital who rarely enter an operating room may contribute much to the smooth and successful handling of operative patients. Teamwork is essential in safeguarding the patient: teamwork of those who care for him before the operation; those who do blood groupings and other important laboratory procedures; those who transport him to and from the operating room; and those who care for him during the postoperative period.

It should not be necessary, but let us consider for a moment, how some of the following errors might seriously interfere with the patient's welfare: an operating field which has been prepared too small; the failure to record on the physical examination sheet the side on which a hernia exists; an elevator passing the floor while a patient waits on a stretcher; a blood grouping not having been done before operation on a seriously ill patient; a doctor or nurse not knowing how to apply a tourniquet properly; a surgeon diverting attention during an operation by telling an irrelevant story; a surgeon or nurse going into a tantrum because of some trivial incident; a nurse not having sterilized a routine instrument for a standard operation; a hospital management trying to economize with a poor grade of suture materials; poor lighting in a tedious operation; a leaking tube on a gas machine. We might add to this list indefinitely, but I believe that a consideration of the factors already mentioned emphasizes sufficiently the importance of each detail.

Of the rules of technique for the surgeon at the operating table, we may include the following:

1. Strict asepsis
2. Careful handling of tissues
3. Complete control of bleeding
4. Careful approximation of the structures and tissues
5. Avoid clamping or tying off of large portions of tissue

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CHAPTER 1

HELPING TO PLAN A NEW OPERATING ROOM

Before the architect draws the first blueprint of a new or remodeled operating room, the planning committee and operating room personnel have already defined the essential elements necessary to provide a safe, efficient environment for patients and personnel.

The planning committee should include representatives of the division of surgery and anesthesiology, the operating room nursing staff, and the nursing service and hospital administration. The members of this committee should work with their co-workers and other resource persons, such as the engineering consultants and an operating room nurse consultant.[1-9] Subcommittees should be composed of nurses, physicians, and others who will study particular aspects of the program, such as selecting equipment, or reviewing standard procedures, or conducting functional analyses. The heads of other departments, such as the central supply service, x-ray, bacteriology, emergency housekeeping and maintenance, should assist the operating room committees in the planning of those factors which affect their role in the care of patients in surgery.

The planners should keep uppermost in their minds the fact that the primary purpose of an operating room is to serve patients, and that the quality of care is determined not only by good functional design, but also by how well the personnel carry out good medical, nursing, and administrative practices and standards. The facilities should aid in promoting job satisfaction of all personnel who will be working in the department. The absence of any one of these factors will mean a mediocre operating room.[10-16]

PLANNING PHASES

First Phase of Planning

The chairman of the building committee should orient the members of the operating room committees to over-all objectives of the project. To provide a good, orderly work plan, the members of the committee may ask themselves the following questions: What are the tasks to be done by this committee? What are the objectives for the department? What problems must be explored? Who will help gather the facts? What methods will be used to gather information? When and where will the committee meet? What is the tentative schedule for doing the job?

in diagnostic procedures, the increased number of births, the aged, and rehabilitation and health programs.

The nursing staff should consult the recent surveys of hospitals in the United States which have been conducted by the U. S. Public Health Hospital Services and Resources.[32-40] These reports do not attempt to present the ideal situation, but they do give a general picture of present trends in various hospitals. They indicate that the patient's average length of stay depends on the type of surgery performed and the size of the hospital.

For example, patients with orthopedic conditions in a 50-bed hospital, stayed nine to ten days; those in a 100-bed hospital stayed ten to eleven days; and those in a 200-bed hospital stayed twelve to fourteen days. The data also indicate that, on the average, those patients in larger hospitals have more extensive surgery and a longer stay in the hospital than do patients in smaller hospitals. Reports also indicate that semiprivate patients remain in the hospital the shortest time and ward patients the longest time. A hospital which has a large number of semiprivate beds, a high rate of occupancy, and a high admission rate for surgical cases may need more operating rooms than those hospitals of the same size which have only ward and private accommodations. The bed occupancy rate becomes the barometer which shows the changing effects in the use of services.

Another factor which influences the space allotment for the operating rooms is the estimated number of major and minor operations to be done each day. According to Block's[38-40] recent reports, in small hospitals, two major operations are usually done to every three minor operations; in large hospitals this ratio increases to three major operations to every four minor operations. In the 100-bed general hospitals an average of 680 major operations and 1,030 minor operations were performed in a year; whereas in the 200-bed general hospitals 1,525 major and 2,150 minor operations were performed; and in the 400-bed hospitals an average of 3,200 major and 4,100 minor operations were done in a year.

The operating room nursing personnel can assist the hospital administrators to set up a plan whereby adequate data can be collected. Such information is not only helpful to administrators and architects, but to nursing service personnel as well. Daily, monthly, and yearly data, showing the time needed to care for patients in surgery, help in determining future facilities needed. Some hospital planners accept the formula of one operating room to every 75 beds, while others suggest one operating room to every 50 beds.[1] It would seem that a more precise formula is needed. Block's[39,40] statistical analysis of the patients' care element in 120 Ohio State general hospitals during the period of 1955 and 1956 seems to support the fact that one operating room to every 50 patients is inadequate. The results of a two-year study (including the time required to care for patients in operating rooms in a 425-bed general hospital)[46] also indicate that ten operating rooms and a cystoscopy unit would be needed in a 400-bed general hospital to care for all surgical patients, the expansion of services, and the personal preferences of the patients and physicians, as well as to provide units

mittee, and the architect then is ready to make the blueprint. It should be posted in a central location so that the nurses can study it as they continue to develop standard nursing procedures and administrative nursing policies.

LOCATION OF THE DEPARTMENT

The location of the operating room department, which depends upon the accepted structural system, should help and not hinder the personnel.[1, 10, 14, 22, 26] It should provide for efficient transportation of patients from their rooms on private, semiprivate, and ward surgical units, from surgery to the postoperative recovery rooms, and of personnel to and from surgery to other departments. The location of the entrances and the elevators for patients, personnel, and supplies is an important part of the planning.

The department may be located in one of the many areas in the building. To control the traffic, however, the operating room should occupy a separate floor or wing, preferably a dead end. In some small and medium-sized hospitals, the operating room department and the emergency, x-ray, and laboratory services are often situated on the first floor of the building. This location provides for efficient, centralized care for patients and allows for future expansion of surgery without disrupting other services. In many medium-sized and large hospitals, the operating room department is frequently situated on the second or third floor. A northern exposure is not too important, since surgery is usually performed under artificial illumination; however, this factor should be considered if air-conditioning is to be used. A northern exposure helps to decrease summer heat and glare.[44, 45]

Number of Operating Rooms Needed

The number of rooms to be allocated for the direct care of patients is influenced by the following factors:

1. The type and classification of the hospital (chronic, general, or specialty).
2. The bed capacity of the hospital.
3. The number of beds to be allocated to medical and surgical patients.
4. The estimated average daily occupancy rate.
5. The average length of stay for patients in the different services (orthopedic, genitourinary, gynecology, and general surgery).
6. The estimated number of major and minor operations each year.
7. The estimated time each unit will be occupied each day.
8. The administrative policies regarding the number of hours the units will be available to patients each day
9. The policies determined for the care of private, semiprivate, and ward patients in surgery.
10. The estimated needs for each service
11. The funds and allotted space available

The demands for operating room facilities have increased due to the use of chemotherapy, the development of ingenious surgical instruments, and anesthesia equipment. Other reasons include early ambulation of patients, advances

When the operating rooms are of different dimensions, the nurse has difficulty in assigning patients to rooms that will provide for safe care and at the same time meet the physician's preference. Often the patient who is to have only a so-called "minor" operation should be assigned to a large room, because he is to have a general anesthetic and intravenous injections, x-rays taken, and diagnostic tests made. When such a patient is cared for in a small room, the equipment cannot be arranged effectively. A small room, 14 feet square, does not provide for a good work situation in which proper medical standards and safety measures can be carried out.

Desirable footage for a general operating unit should be 20 feet wide and 18 feet long, with a ceiling 9 to 10 feet high. The footage should provide for an immediate patient area of 10 feet in length and 7 feet in width, with a surrounding area of approximately 3½ feet beyond the head of the patient, 5½ feet at the foot of the operating table, and 4 feet on each side of the table. Larger rooms may be needed to care for patients who will require special major surgery and other treatments and tests.[1, 48]

Frequently, the so-called fracture room is not large enough for use of a fracture table, fracture appliances, and x-ray equipment.[43, 49] Due to lack of sufficient operating units, the emergency patient or outpatient is often treated in a fracture room that is not equipped for minor or major "open" surgery. In such situations the medical standards are endangered, especially when plaster dust is floating in the air.[25] Before the architect draws his first blueprint, the committee should determine the functions of this room and the kind of equipment to be installed in it. Is the orthopedic patient in surgery to be moved to this room for the application of his cast? Will he be transported on the fracture operating table, and, if so, is the door wide enough? Can the recommended safety measures be carried out?[9, 18, 20, 21, 50]

The planning committee must decide if the cystoscopy room is to be located in surgery or adjacent to the x-ray department. The decision usually depends on the kind of services, the bed occupancy of the hospital, and the number of outpatients to be cared for. Proper equipment must be installed in this unit to assure safe, efficient service. The planners should also decide upon the space to be allotted for patients admitted to the endoscopic, nose, and throat services.[51-53] It will be necessary to determine the area needed to anesthetize the patients and the kind of equipment to be installed.[54, 55]

In operating rooms where medical and nursing education programs are being conducted, adequate teaching facilities will be needed.

MATERIALS FOR WALLS, CEILING, FLOOR, AND WINDOWS

The construction of the rooms in surgery and the materials used should provide for a safe and quiet environment and should help conserve the workers' energy and reduce maintenance costs.

Walls and Ceiling.—The surface materials of the walls and ceiling must meet sanitary standards and fire protection rules, decrease noise, control heat and cold, and increase the lighting power of the illumination system.[44, 56-59]

for teaching purposes, for housekeeping and maintenance tasks, and for segregation of cases.[46] With better standardization the time needed to carry out operating room nursing procedures often can be shortened, thus providing more available facilities for surgery.

RELATED FACTORS CONCERNING ALLOTTED SPACE

The architectural design of an operating room not only affects the work plan, but also the rate of postoperative infections. It is evident that some major operating room service problems are due to expansion of services and others to poor medical standards and policies, lack of trained personnel, and/or lack of money. Some of these difficulties, however, can be remedied by better preliminary planning for new facilities and equipment.

Two major problems related to design are the small, so-called minor room and an insufficient number of rooms to meet the preferences of the physicians and to ensure the safety of the patients.

In many hospitals minor rooms are being used to prepare individual sterile setups on a production line basis. The efficiency of grouping the tasks of preliminary preparation may be sound, but usually such facilities do not enable the team to carry out the plan safely and efficiently. The operating room unit is not equipped with open shelves for storing a large number of sterile packs and instrument trays. Its size is inadequate for arranging tables and Mayo stands effectively or for storing the sterile setups until they are used. As a result, setups are often stored in the main corridor, the unoccupied plaster room, the anesthesia room where equipment is kept, or in a room where a patient waits for surgery.

The suite should have a sufficient number of operating rooms, each with a substerilizing unit, so that each team can prepare and care for the patients assigned to the unit. This arrangement eliminates the need to take soiled equipment to a central utility area for terminal sterilization and to cover sterile setups and store them. When each worker is oriented to his job, the setups are arranged to conserve the personnel's time, and when standard procedures are defined, preliminary preparation can be done in each room before the patient arrives. This plan permits the nonprofessional worker to work with the graduate nurse at all times in caring for patients.

The central sterile room, however, may be the answer to one hospital's problem, especially if it has many active services. To conserve costs, ensure proper asepsis, and create job satisfaction for all workers, the central sterilizing unit should be properly designed and located adjacent to the central supply service. The sterile and unsterile supplies may be transferred by a conveyer system. The space and facilities should exemplify the principles of safe care and work simplification.[7, 24, 47]

Operating room nurses should consider the advantages and disadvantages of each functional system as it relates to the proposed constructional plan. Any system will be influenced by the degree to which procedures are standardized and work methods defined and accepted (Chapter 4)

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Walls and Ceiling.—The surface materials of the walls and ceiling must meet sanitary standards and fire protection rules, decrease noise, control heat and cold, and increase the lighting power of the illumination system.[44, 56-59]

Walls should be insulated to make the room temperature more comfortable and reduce heating and cooling costs. The unions of wall and floor and those of wall and ceiling should be rounded to make cleaning easy. The surface of walls should be made of a washable, nonabsorbent, durable material, such as glazed tile, tile board, ceramic tile, or plastic material.[22, 60] The tile should extend over the entire wall or from the floor to five feet below the ceiling. A green ceramic tile wall with a glazed surface is easily cleaned and tends to resist dust particles. A nontiled surface should be plastered and painted with a glossy, washable paint of a restful color.[61] Wall openings for pipes and electric outlets must fit snugly and the openings on the wall must be reinforced with tight-fitting metal collars to prevent the entrance of rodents.

Color.—The color selected for walls should contribute to muscular eye balance, since eye fatigue usually is caused by overmuscular activity. Bright colors tend to be conducive to muscular activity, and soft colors are more conducive to mental activity.[60, 61] Although gray is often selected because it does not show soiling readily, authorities have recommended its use in those areas where workers are doing tasks which require considerable visual and mental concentration and where the operator must focus his eyes on bright red objects, such as blood vessels. Greenish blue or bright blue tends to distort the operator's focus. A light green is considered a good color since it has a fresh appearance and a slightly passive quality. Built-in furniture should harmonize with the color of the walls. The walls of storage areas should be white, as it has a reflective power of about 75 per cent.

The ceiling should be covered with an accoustical, washable material, such as tile, plaster, glazed tile, metal and wood combination, or vinyl resin plastic material It should also absorb about 85 per cent of the noise striking its surface. A warm soft color should be selected since it increases the actual foot-candles and reflects the light to the working plane. Dark colors should not be used since they absorb and waste light.

Windows.—The design should not permit the entrance of outside air and dust. The windows made of double-insulating, fixed glazed glass diminish the glare and provide sufficient natural light for workers to carry out housekeeping and indirect nursing duties Light-proofing should be installed on the windows in those rooms where surgery is performed, using lensed instruments or a head mirror.

Doors.—For the transportation of patients, each operating room unit requires one main door which opens into the main corridor and a second door which opens into the substerilizing unit The worker should be able to enter the substerilizing unit from the main corridor. If there are two corridors, the substerilizing unit usually opens onto the utility corridor The doors should be of fireproof material; the frames should be of adequate width and flush with the wall. Each door should open both ways at a proper angle, and should contain an inner spring and a rubberized guard attached to the free side. In some units the doors are equipped with an electronic device which opens the door when the person touches it. A glass panel is usually inserted in the door leading to the substerilizing room, and the glass window in the main door is usually encased in a panel, with a shutter to be raised when needed[1]

Floors.—The safety of patients and workers begins with proper and adequate installation of conductive flooring through which the electric charges usually travel. A conductive floor forms the electric pathway which can discharge static electricity everywhere on its surface as rapidly as it is generated. Since the success of flooring depends on its electric resistance, its construction and composition should meet the latest regulations recommended by the Underwriters Fire Protection Association.[50, 55] Some authorities have found that if the floor has good conductivity, it is not necessary to have it connected by a low resistance route to the earth itself. Research has shown that a floor will function effectively as a dispersant of static charges if the total neutralizing circuit formed by the objects and the floor does not exceed one million ohms. A minimum resistance of 250,000 ohms is generally recommended for operating room floors.[29, 55, 56]

The floor should possess fireproof and waterproof qualities. Its surface should be nonporous and free of cracks, thus preventing openings between the tiles or squares where conductive liquids, dirt, and pus tend to collect.[25, 62, 63] This also facilitates cleaning and reduces hazards. The flooring should be resistant to deterioration from biologic fluids, detergents, germicides, salts, and waxes. Such materials also reduce the floor's conductivity. The flooring should be able to withstand mechanical abuse by heavy objects and general wear. To reduce noise and ensure the safety of workers, a floor should have acoustical and nonskid qualities. A resilient property eases the strain of persons standing on it for long periods.

Such materials as marble, ceramic tile, linoleum, and rubber are generally far above the maximum resistance limit recommended for floors in surgery. Terrazo floors commonly include metallic strips as part of the design. These metal grilles provide an excellent path for the grounding of static charges, but only if the strips are close enough to provide for effective grounding of equipment. However, the resistance of this flooring may fall below that of the lower limit recommended to ensure the safety of persons against electric shocks. Vinyl-resin conductive tile is also being used as flooring for operating rooms. Research studies indicate that this material meets the requirements set up by the National Fire Protection Association.

ARTIFICIAL ILLUMINATION AND ELECTRIC APPLIANCES

The installation of alternating current circuts, outlets, cords, and all electric appliances in the operating room department should meet the requirements set up by the National Fire Protection Association for hospital operating rooms.[55, 56] It is important that nurses understand the safety prevention regulations and interpret them to others. Sufficent electric outlets, both 110 and 220 volts, and suitable wiring to carry various types of equipment are needed. An explosion-proof x-ray view box, a wall clock, an automatic fire-alarm system, and an emergency lighting system are needed.

To prevent sparks or arcs from occurring during the use of the ordinary electric system, the receptacles and attachment plugs must be a part of a unit device with an explosion-proof interlocking switch. The plugs should be in-

stalled not less than five feet above the floor of the room where anesthetic agents are used. The noncurrent metal parts of portable electric appliances must be grounded according to the recommended practices set up by the National Fire Protection Association in Bulletin 2676.[29, 64] All flexible electric cords which are connected to portable equipment and lamps must be continuous and switches must not be incorporated in them.

Ceiling lights and surgical lamps should operate on different switches. Ceiling lamps should be flush with the ceiling, and suitable lamps should be installed in the cabinets.

Ideally, one surgical lamp should supply all the light needed at the operative field. The light should not pick up shadows from the operator's hands or from the instruments. It should be of a color corrected to near that of natural daylight without producing excessive heat. For surgery, the light requirement usually is 1,800 foot-candles over the operating room table.[44, 57] The light should cover a circular area eight inches in diameter, and it should be about 900 foot-candles everywhere in that circle. Lamps which are installed in a fixed position should be enclosed in an approved manner. Lamps with camera installed permit pictures to be taken without disturbing the operators or endangering asepsis. Some lamps now on the market are designed so that several operators can see to work in a small, deep cavity at the same time. Electricity should be supplied to an apparatus from an individual transformer which has been connected to an outlet receptacle by means of an approved plug, or the tool should be connected to a common transformer which has been installed in a nonhazardous location.

AIR HYGIENE

Ventilation and Air-Conditioning

Proper air hygiene is of great importance to the comfort and health of patients and workers. Air-conditioning affects both the physical and chemical conditions of the atmosphere within the room. An air-conditioning system affects the temperature, humidity, and motion distribution, but it seems to have limited power in controlling dust and little effect on bacteria and odors.[19, 45, 62, 65]

To provide a safe atmospheric condition for the patients in the units several factors are considered: (1) the age and the physical and psychologic condition of the patient, (2) the type of operation to be performed, (3) the type of anesthetic to be administered, and (4) the number of layers of sterile sheeting to be placed over the patient.

Temperature and Relative Humidity.—The average temperature of the room may range from 68° to 80°F, depending upon the patient's condition and age. The temperature usually can be adjusted by turning the automatic control switch "On" or "Off."

In the presence of a relative humidity of 60 or 70 per cent, the materials in the room will absorb some substances onto their surfaces, thus making them slightly electrically conductive. A high relative humidity helps to reduce the hazards of electrostatic spark discharges, but it does not completely control dis-

charges or air-borne organisms.[20, 63] A hygrometer is needed to determine the proportion of moisture in the air. The readings of a hygrometer, calibrated in terms of per cent, indicate the relative amount of moisture in the air, but not in the actual content.

Distribution of Air

The outside air or refrigerated air should be introduced into the room at a more rapid rate than it is exhausted so that the pressure in the room is slightly positive. However, the pressure used must not cause combustible agents to be distributed throughout the room and must not encourage cross-infection.[25, 17, 63] The air should enter each room through one or more inlets, but should only be exhausted by one outlet. The inlet may be situated in the ceiling or in the same wall area in which the exhaust outlet is situated.

Some authorities state that the air supply which is mechanically brought into the room should be changed at the rate of ten to twelve times each hour during the warm months and about eight to ten times each hour during the winter months. When the ventilating ducts are being cleaned and swept, the air should change at the rate of fifteen to twenty times each hour. Filters and washers or precipitators are used to control the entrance of dust into the building, remove dust, and control humidity.[45]

Forced-draft ventilation and air-conditioning are used in some operating rooms. In the summer months the underground water at 50°F. is circulated through the coils in the ceilings and walls to cool the rooms, and during the winter months the water is heated before it flows through the coils. When 100 per cent outside air is used, it is drawn through intake ventilators, filtered, conditioned, and then distributed through a system of insulated ducts which are installed in each room. To prevent the entrance of rain, snow, or dirt, the intake ventilators contain dampers that close automatically when the system is not operating. During the purifying process the carbon dioxide is not removed from the air, since it, like a high relative humidity, helps to control the hazards of static electrostatic charges.

Chemical Disinfection, Radiation, or Irradiation of Atmosphere

Air disinfection is the sanitary equivalent of ventilation. Threshold sanitary ventilation is the minimum rate at which organisms are killed or at which there is prevention of an epidemic spread of air-borne contagion.[63] Lethal bactericidal radiation may be rated in terms of "move" lengths, and lethal irradiation in terms of foot-watts. Radiant disinfection of air follows the law of mass action and the monomolecular law of reaction velocity.[45, 63, 66]

Studies indicate that humidity is one of the basic factors governing the bactericidal effect of ultraviolet rays on organisms suspended in air. At present, the use of ultraviolet is limited, since the germicidal action has a surface effect only and the rays do not penetrate the surface of liquids; thence, organisms in droplets are not destroyed. The action of ultraviolet rays requires time to act, and the *ozone* generated from ultraviolet lamps requires adequate ventilation to prevent

detectable odor from the concentrations. Prolonged exposure to the ozone is also injurious to a person's skin, tissues, and eyes, and the lamps require frequent checking to prevent the formation of a dust barrier. If weak irradiation rays are used in surgery, they should be directed parallel to the floor above eye level. Such rays are more economical and more effective than irradiation of recirculated air. Wells[63] and others report that ultraviolet rays will bring about a 50 to 75 per cent reduction in the bacterial air count, but only under controlled conditions.

Studies of the lethal powers of glycol and aerosol vapors in different room temperatures and humidities are now being carried out.[66] Studies also indicate that glycol is nontoxic in use, but is only effective in a relative humidity of 20 to 50 per cent.[63, 68]

INTERCOMMUNICATION SYSTEM

To save nurses' steps, increase the over-all efficiency of the hospital, and provide for immediate assistance, the operating room areas and the central station should be equipped with an effective communicating system. It may comprise three switches, a light, and a speaker-microphone at each outlet. A switch situated in the central station permits the page to go out to the different units—operating rooms, dressing rooms, lounges and offices—and the person in any unit can speak from his location. Wired telephone devices may be installed in certain areas so that physicians can dictate their operative notes. A light-signal-paging system for physicians may be installed throughout the hospital by means of an ultra-high frequency radio system.

PIPED OXYGEN AND CENTRAL VACUUM SYSTEM

A central piped system of oxygen decreases maintenance costs and minimizes the fire hazard which exists when oxygen in cylinders is used. The system usually operates at a pressure of 40 to 50 pounds per square inch.

A central vacuum system should provide for a continuous suction of about 20 inches negative pressure to each operating room unit by means of an outlet. To meet sanitary standards, the fittings of the vacuum system include brass clean-out plugs, which are installed at all changes in direction of the piped lines and at their ends.

THE FACILITIES AND ARRANGEMENT OF VARIOUS ROOMS

Corridors.—The main corridor for patients should be wide enough to permit the passage of beds. The lower half of the walls should be covered with a protective material. A recessed area may be allocated for the storage of large pieces of equipment. Drinking fountains should be installed in the corridors.

Units.—The operating rooms comprise the hub from which the entire department is designed. The plan aims to (1) decrease the nurses' time spent in walking to and from operating rooms to utility rooms and offices; (2) increase working time of the nursing personnel and surgeons in the units; (3) permit the nurses to spend more time with their patients; and (4) provide for a quiet and safe environment.

Essential Equipment for a General Operating Room.—Safe furniture is made of metal or electrically conductive material which has contact with the floor through conductive casters, tires, or leg tips.[29, 55] The essential built-in pieces of equipment for an operating room unit include an explosive-proof x-ray view box, a cabinet with adjustable glass shelves, an explosive-proof suction apparatus, electric outlets, cords, and lamps.

The routine depreciable pieces of equipment for an operating room unit include the following:

- 1 Operating room table with conductive rubber pads and attachments to suit the service
- 1 Spotlight, explosion-proof, adjustable
- 3 Revolving stools, adjustable in height from 17 to 31½ inches; one with a rubberized, explosion-proof cushion
- 2 Operator's footstools, 30 inches long, 10 inches wide, and 8 inches high, with explosion-proof padded feet
- 1 Operator's footstool, 14 inches long, 10 inches wide, and 8 inches high, with explosion-proof padded feet
- 3 Kick-buckets mounted on steel frames with swivel casters
- 1 Sponge basin, 13 by 17 by 5½ inches deep, mounted on a steel frame with swivel casters
- 2 Utility tables with undershelf, one for skin preparation and the other for gloves and gowns
- 1 Instrument table, stainless steel composition, with undershelf, mounted on swivel casters, and adjustable
- 1 Suction apparatus, explosion-proof
- 2 Instrument Mayo stands, adjustable, desired size and type to fit over the patient and table
- 1 Anesthesia table with drawer
- 1 Irrigator, double-hook, adjustable
- 1 Cautery with blades and cords, explosion-proof
- 1 Electrosurgical unit, explosion-proof, with attachments

To perform certain neurologic procedures, the additional equipment includes cerebellar headrest, Adson chair (if desired), cranial crossbar for holding sterile sheets away from the patient's face, ventricular table and brain table (if desired), metal sheet or metal tray, cortical stimulation apparatus, headlight and holder, and extension outlet circuit. For some kinds of orthopedic procedures, a fracture table and appliances for taking x-rays and immobilizing extremities will be needed. (Chapters 6 and 17.)

Dispensable pieces of equipment for an operating room include sterile containers with suture materials, instruments, transfer forceps and jar, infusion sets and intravenous solutions, cardiac arrest tray, bottles containing germicides and skin detergents, sterile textiles—sheets, sponges, towels, and cotton (Chapter 4). Additional items will be needed for the neurosurgical, endoscopy, nose and throat, and cystoscopy units.[12, 42, 51-53, 67]

Scrub-Up Unit.—Regardless of its location in the department, certain pieces of equipment are needed. (1) Three or four sinks or a long trough of sufficient size is required to accommodate each operating room team. (2) The sinks should be spaced far enough apart or the trough sink long enough to protect the operator's cleansed arms and hands from the soapy spray falling from another person's arm or brush. (3) The faucets should have high outlets. (4) The hot

and cold water supply should be controlled by knee or elbow valves, preferably the knee-type valves, as they leave the person's hands free. Foot pedals should not be used, as they collect dust and dirt and increase maintenance costs. (5) A dispenser system for the cleansing agent may be situated between each two scrub sinks or at different areas above the trough. (6) An alcohol dispenser may be situated against the wall, if desired. (7) A metal shelf should be secured to the wall at a level above the sinks.

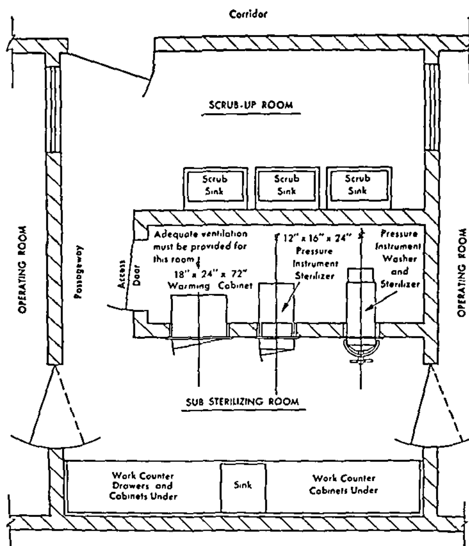


Fig 1 —The arrangement of sterilizers in the substerilizing room for each pair of operating rooms (From Perkins, J J Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

Substerilizing Unit for Each Operating Room.—The substerilizing room should open onto one or two operating rooms and onto the utility corridor or main corridor. The worker should be able to enter the substerilizing unit without going through the operating room.

The essential facilities for a sterilizing unit include (1) a pressure high-speed instrument sterilizer; (2) a pressure instrument washer-sterilizer; (3) two metal

work counters, one with open shelves below for storing stools and table appliances, and the other with drawers and cabinets under it for storing sterile goods; (4) a sink 20 inches wide and 24 inches long, with a gooseneck spout between the counters; (5) a metal shelf secured to the wall over the sink at a suitable height for the average worker; (6) metal shelves for storing solutions, blankets, sheets, patients' shirts, binders, empty bottles, etc.; and (7) floor space for a linen hamper, refuse cans, and work area.[5, 58]

If each patient is to be prepared in the room and instruments are to be sterilized in the sterilizing room before and after the operation, an instrument pressure washer-sterilizer and a sufficient working area are essential. The substerilizing room must be adequately ventilated. A radiant energy (dry heat) sterilizer should be available to sterilize cutting-edge instruments (Fig. 1).

Instrument Storage Room.—All packaging and autoclaving of surgical goods and basins should be done in the central supply service. The instrument trays should be prepared in the units.

Routine instruments for various types of surgery should be kept in trays either in the units or in the instrument room. Extra or special equipment should be stored in the instrument room (Chapter 4). This room should be equipped with open pull-out sectional cabinets. They should be about 5 feet high and 12 inches wide, and should have rows of metal hooks secured to the back so that forceps can hang with their jaws open. A built-in metal cabinet measuring about 5 feet high, with glass adjustable shelves about 12 inches wide, may be used to store special instruments and catheters. There should be a one-half-inch space at the back of the shelves to provide for adequate air circulation. A small sectional metal cabinet comprised of opaque pull-out compartments of various dimensions is needed for storage of small pieces of equipment, such as suture materials, bone plates and screws, needles, catheters, and drainage tubing. A work table or pull-out shelves on which to place pieces of equipment or trays will be needed.

Adequate lighting is necessary, and proper ventilation is required to control dampness, sweating, and decrease air-borne bacteria. Bulletin boards should be recessed in the wall area, convenient to the worker. The size of the instrument room will depend on the amount of equipment to be stored. If routine setups are standardized, prepared in sets, and kept in the units, less floor space is needed in this area.

Utility Room.—The utility room is used to clean and test large pieces of equipment and to prepare basin setups and other items before they are sent to the central supply service or the instrument room. The facilities of this room may include a double sink, two work counters with drawers and cabinets under them, hot and cold water supply, bulletin boards, work stools, refuse container, and linen hamper. Housekeeping supplies, paper towels, cleaning utensils, extra basins, and specimen bottles may be stored in this room. Adequate lighting fixtures and ventilation are important considerations.

Anesthetic Room, Office, and Storage Space.—In many hospitals the patient is anesthetized on the operating table in the unit in order to ensure the safety of

the patient and eliminate the need to disconnect the gas machine as the patient is being moved into the room from the induction room. The number of anesthetic rooms depends on the needs of patients. Space for an office and for the storage of anesthetic machines, tubes, and drugs in use will be needed.[54] The area must be properly ventilated. The office equipment may include one or two desks, chairs, filing cabinets, open-shelved cabinets, and bulletin boards. If equipment is to be prepared in this area, open shelves, a sink with counter, running water, and adequate lighting fixtures will be necessary.

The Darkroom, Laboratory, and Specimen Room.—If the operating room department is not located near the x-ray department, a small area may be allocated for the development of x-ray films. The equipment in the room should include a small developing tank unit, film storage box, light-proof windows, refrigerated water supply, a small counter, and several metal hooks secured to the wall for hanging wet films.

Another area may be needed for performing frozen-tissue sections. The equipment should include a sink, counter, a cabinet with door and lock for storing laboratory equipment, a gas outlet, and a truck or standard for a cylinder of gas. This room must be properly ventilated to remove odors and gaseous fumes. The installation of equipment and its use must meet the latest safety measures recommended by the National Fire Protection Association.[61] Open shelves may be installed for storage of specimens during the day if there is no tube system through which specimens can be sent to the laboratory. Adequate storage units for photographic equipment may also be situated in this area.

Supervisor's Office, Reception Center, Conference Room, and Medical Secretary's Office.—In hospitals of 150 beds or more, a central office is needed, and should be equipped with two desks, chairs, blackboards, filing cabinets, bookcase, proper lighting fixtures, and adequate ventilation.

A recessed reception area may be situated in the main corridor near the main entrance used by patients and visitors. It must be properly lighted and ventilated. The equipment needed for this area may include a desk, chairs, intercommunication switches, and an information board for listing of operations. The board may be divided into columns, with typed headings or runners in which printed metal letters are inserted.

The conference classroom should be located away from traffic. The room should be equipped with tables, chairs, blackboard, bulletin boards for displaying charts, x-ray viewbox, shelves, filing cabinets, and equipment for showing slides, filmstrips, or movies.[63] The medical secretary's office may be located near the doctors' lounge.

The lounges for the doctors and nursing personnel should be situated near the entrance to the department. These rooms must be adequately ventilated and air-conditioned to decrease air-borne bacteria and to provide for a comfortable environment. Each lounge should be equipped with individual clothing lockers, and open shelves secured to various wall areas near lockers for storage of clean operating room attire, footgear or conductive shoes, and gowns and caps for visitors.

A washroom should adjoin each dressing lounge. The necessary pieces of equipment include a wash basin, showers, lavatories, mirrors, containers secured to the wall for the storage of paper cups, paper towels, and liquid soap dispensers, shelves for the storage of bath towels, and one or two linen hampers.

A refreshment lounge may be situated near the lounges, and, if it is, it should be furnished with chairs and table, and equipped with an electric hot plate and a small refrigerator.

The stock-supply closet should be large enough to accommodate the standard stock items, such as housekeeping supplies, extra basins, suture materials, bed linen, patients' shirts, binders, operating room apparel, and bath towels. Machines, such as cauteries, suction pumps, or special operating room table attachments, may be stored in this room. The open metal cabinets should have adjustable shelving. In some operating rooms these pieces of equipment are stored in the utility workroom. The names of the disposable items and the standard amounts needed for each day or week should be written on small cards which are attached to the various shelf areas.

A drug closet should be situated in the nurses' office or off the corridor near the operating rooms. Ampules of medications and bottles of disinfectants are stored on metal, adjustable shelves. A small narcotic cabinet with locked door is secured to one shelf. The key to the cabinet is kept by a graduate nurse. Forms which are used to record narcotics are also kept in this room. A pull-out shelf is attached to the lower cabinet shelf. The room should be painted white and should be well lighted.

Mop Sinks.—Mop sinks should be situated near the operating rooms, and the number needed will depend upon the size of the department. Each sink should be recessed in the floor and the spout from the spigot should be short enough so that it will not protrude into the soiled bucket and contaminate the water supply due to backflow. The area should be adequately ventilated. A metal shelf should be secured to the wall for storage of cleaning agents and clean laundered mops. Spring holders should be secured to the wall area for the mop handles and other pieces of equipment. A metal refuse can with movable casters should be placed in this room if an incinerator chute does not open into the department. Space should be available in one area for the storage of an electric vacuum and its appliances.

Viewing Galleries.—In teaching centers a viewing gallery may be installed above the operating room and over the operative field. It usually includes a circular area, which is separated from the operative field by a shield of glass. With the advances in television as a teaching tool, and the ineffectiveness of galleries as a whole, it would seem that galleries may be nonexistent in surgery in the near future.

Telecasting surgery requires a room of sufficient size for the installation of television equipment and teaching tools.[69] The cameras usually are situated in the operating room lamp or on dollies, and the cameras are controlled by personnel in a central control room, which is situated in another part of the building.

Facilities for Disposal of Soiled Laundry, Refuse, Specimens, and Records.—The laundry chute should be situated near the units. Modern hospitals are now

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26. Rosenfeld, E. D., and others: The Tenth Plan Passed All Tests, Mod. Hosp. 82:70, May, 1954.
27. Rosenfeld, E. D, and Abramson, L. A.: Time and Distance Determined the Plan (Types of Construction Studied), Mod. Hosp. 82:67, May, 1954.
28. Wheeler, T. E.: Architectural Planning and Equipping the Operating Room, Institute Operating Room Administration, American Hospital Association, Chicago, 1952.
29. Explosion Proof Electrical Equipment for Hospitals, Bull. 2676, Syracuse, N. Y, 1956, Crouse-Hinds Co.
30 Miller, O T., Schmidt, R. F, and Phillips, B. G.: Applications of Germicidal Ultraviolet in Infectious Diseases in Laboratories, Am. J. Pub Health 45:1120, Nov., 1955.
31. Davis, A. E.: Efficient Planning Starts at the Top, Mod Hosp. 85:55, Dec., 1955.
32 Block, L.: Prototype Study: 100-Bed Hospital, Mod. Hosp. 81:76, Oct., 1953.
33. Block, L.: Prototype Study: 200-bed Hospital, Mod. Hosp. 82:76, Jan., 1954.
34. Block, L: Prototype Study: 125-Bed Hospital, Mod. Hosp 82:53, Feb, 1954.
35. Block, L.: Prototype Study: 25- to 200-Bed Hospitals, Mod. Hosp. 82:65, June, 1954.
36 Block, L.: Prototype Study: 400-Bed Hospitals, Mod. Hosp 83:78, July, 1954.
37. Block, L.: Analysis of Patient Care Elements: 50- to 74-Bed General Hospitals, Mod. Hosp. 86:66, April, 1956
38 Block, L.: Analysis of Patient Care Elements. 100- to 124-Bed General Hospitals, Mod. Hosp. 86:72, May, 1956.
39 Block, L.: Analysis of Patient Care Elements: 200- to 299-Bed General Hospitals, Mod. Hosp. 87:84, July, 1956.
40 Block, L: Analysis of Patient Care Elements: 300- to 399-Bed General Hospitals, Mod. Hosp. 87:86, July, 1956.
41. Williamson, J. A.: A Committee for Equipment Standardization, Hosp. Management 82:102, Aug, 1956.
42. Markus, F. E.: Major Operating Room, Mod. Hosp 79.59, July, 1952.
43. Markus, F E: Minor Operating Room, Mod Hosp. 79:80, Aug., 1952.
44. Berry, L.: Modernized Lighting for Surgery, Hosp. Management 78:50, July, 1954.
45. Taylor, J.: Recirculating Air in the Operating Room, Hospitals 29:98, May, 1955.
46 Personal communication and study, Roosevelt Hospital, New York City.
47. Markus, F. E.: Time and Motion Studies in Operating Room Suite, Mod. Hosp. 78:80, June, 1952
48 Hospital Survey of Services, U. S Public Health Department Hospital Services and Resources, Washington, D C, 1953, U. S Government Printing Office
49. Markus, F. E: Plaster Room, Workroom and Storage, Mod. Hosp. 79.83, May, 1952; 79:78, Sept., 1952, 79:85, Nov, 1952; Operating Room Storage, Mod Hosp: 80:71, Jan, 1953.
50 Neergaard, C F.: Safety in Surgery Starts on the Floor, Mod Hosp 81:126, Aug, 1953.
51. Blizzard, G. S.: Ear, Nose and Throat Operating Room—for Endoscopy, Mod Hosp. 82:104, Jan, 1954
52 Brett, E.: Every Operating Room Needs a Broncho-Esophagoscopy Unit, Mod Hosp 81:104, July, 1953
53 Klemme, R. N.: Operating Room in Neurosurgery, Am Supply Trade J 39-43, 1952
54. Berber, H. Anesthesia Storage Closet, Hospitals 29:100, April, 1955.
55 National Fire Protection Association. Recommended Safe Practice for Hospital Operating Rooms, N.F.P.A. No 56, endorsed by American College of Surgeons, American Hospital Association, U. S Veterans Administration, Boston, 1956, National Fire Protection Association.
56 Barrett, R. H. Explosion Hazards in the Operating Room, Hosp. Topics 33:86, Oct, 1955.
57 Griffin, N. L: Recommended Lighting Practices Put the Hospital in Its Best Light, Mod. Hosp 84:84, March, 1955
58 Hopkins, E. S, and Elder, F B: Practice of Sanitation, Baltimore, 1951, Williams & Wilkins Co
59 Blumenauer, G, III: Sound and Noise and What to Do About Them, Hosp Progress 36:63, April, 1955; What Can Be Done About Noise? Am J Nursing 1:51, 1955.

equipped with chutes leading to trash bins and incinerators for disposal of refuse. Chutes are constructed so that they can be flushed with hot water as often as necessary to keep them clean. Receptacles for soiled face masks, soiled gloves, and refuse should be situated in each unit. The cans should consist of a cover and foot pedal.

The tube system for sending specimens to the laboratory may be installed near the units, and a tube system for sending or receiving charts, forms, and notices should be situated near the central office in the department.

REFERENCES

1. Architectural Design of Hospitals, Chicago, 1954, Hospital Architectural Association.
2 Berber, H.: Planning and Furnishing an Operating Suite, Hosp Management 82:37, 56, Oct., 1956
3. Markus, F. E: Time and Motion Studies in Operating Suite, Equipment Improvements Based on Motion Economy, Mod. Hosp. 79.76, Dec, 1952.
4. Mustard, A. I.: The Nurse on the Hospital Planning Committee, Am. J. Nursing 12:1241, Oct, 1952.
5. Perkins, L.: Principles and Methods of Sterilization, Springfield, Ill., 1956, Charles C Thomas, Publisher.
6 Prickett, E: Application of the Methods Improvement Technics to the Operating Room, Hosp. Topics 32:78, April, 1954
7. Beams, Rosalie· Helping to Plan a New Hospital, Am. J. Nursing 57:202, Feb, 1957.
8 Clark, A.: The Architect's Role Is Seldom Buttered, Mod. Hosp. 86:26, March, 1956.
9. Neergaard, C. F.: Hospital Construction, Canad. Hosp 27:38, Jan., 1950.
10 Daley, L A. Special Architectural Features of Clarkson Hospital, Mod Hosp 84:58, June, 1955.
11 Kling, V G· Departures in Design, Mod. Hosp. 84·56, April, 1955.
12 Lindroth, K· Principles Behind the Method Improvement Technic, Hosp Topics 32:74, April, 1954
13 Nocka, P F.: Time and Motion Theories Get Practical Results, Mod Hosp 80:76, May, 1953.
14 Perrin, H G Everybody Helped to Plan the Hospital, Mod. Hosp. 84:55, June, 1955.
15 Are Your Hospital Rooms Explosion-Proof? Hosp Management 82:42, Oct, 1956.
16 Berke, M Electronics Comes to the Operating Room (Mount Zion Institute of Human Physiology), Mod Hosp 85·73, Dec, 1955
17 Beach, R Electrostatic Explosion Control in Hospital Operating Rooms, Hosp Progress 37·65, March, 1956
18 Daniel, C E Functional Engineering Is as Important as Functional Architecture, Mod. Hosp 75:120, Sept, 1950.
19. Davenport, S J, and Margis, G G Air Pollution and Bibliography, Bull 537, U S. Bureau of Mines, Washington, D C, 1956, U. S Government Printing Office, p. 488
20 Thomas, J G Fire and Explosion Hazards With Flammable Anesthetic Agents and Their Control, J Kentucky M A 54·27, Jan., 1956
21 Wiltrakis, G A Safety in the Operating Room, Springfield, 1954, Department of Public Welfare, State of Illinois
22 Design Post-Mortem at Rockford Memorial Hospital, Mod Hosp. 84·65, 82, March, 1955
23 *Ehrlich, I. There Are Some Booby Traps in Those Blue-Prints, Mod Hosp 84:80, May,* 1955.
24 Northrup, M W, and others· Race Track Plan Cuts Down the Distance From Nurses' Stations to Patients' Rooms, Mod Hosp 75:59, Oct, 1950
25 Walters, C W: Control of Infection in the Operating Room Calls for Good Design and Safe Management, Mod Hosp 78.98, Jan, 1952

CHAPTER 2

PROVIDING A SAFE ENVIRONMENT AND STERILE EQUIPMENT AND MATERIALS

In accepting the responsibility for providing a safe environment and properly prepared equipment for the care of patients during surgery, the operating room staff and other hospital personnel must carry out safe, reliable procedures. Safety measures and procedures are based on the principles of medical and surgical asepsis which aim to prevent the patient from being exposed in any way to disease-producing microorganisms. The ultimate goal of any physical or chemical process is to destroy all disease-producing organisms in materials or on inanimate objects used for patients—and to control air-borne organisms.

BACTERIOLOGIC CONSIDERATIONS

Mechanical cleansing, bacterial disinfection, and sterilization processes are established through knowledge of the many ways all living microbial life and other forms of life can enter the body of man; how they react in living tissue and chemical substances; and how certain physical and chemical agents can be used to destroy different types of bacteria.[1-5] The selection of a chemical or physical process is influenced primarily by the types of bacteria to be destroyed, and, second, by the kinds of equipment or inanimate object to be prepared.[4-8]

Most pathogenic bacteria live as saprophytes or parasites. The saprophytes exist in dead organic materials, such as detritis, feces, or dried blood, whereas parasites survive on living organic materials, such as tissues and chemical substances in man.[3, 9-11] The so-called vegetative bacteria include those which do not form spores (staphylococci and streptococci) and those which are capable of spore-forming (*Clostridium tetani* and *Clostridium welchii*) but are not in the spore stage at a particular time. The bacterial spores can resist drying and exposure to high temperatures and a high concentration of toxic substances. Under such conditions the organism does not germinate a cell, but can live in a spore state for years.

Most pathogenic bacteria have one definite pathway which is used to enter man and usually are not disease-producing if another route is used. The portals of entrance are the mouth, nose, throat, and skin. A few bacteria can enter by one of several routes; however, the route used generally determines the kind of disease they can produce. The portals of exit depend on the area in which the disease process is located. These facts have a scientific significance in the con-

60. Ketcham, H.: What Is Color: Functional Color in the Modern Hospital, Mod. Hosp. 84:66, April, 1955.
61. Birren, F.: Color Makes Hard Work Easier, Mod. Hosp 84:61, June, 1955.
62. Stern, A. C., and Greenburg, L: Air Pollution. The Status Today, Am J. Pub. Health 41:27, 1951.
63. Wells, W. F.: Airborne Contamination and Air Hygiene, Cambridge, Mass., 1955, Harvard University Press.
64. National Fire Protection Association: Recommended Safe Practice for Hospital Operating Rooms, No. 56, Chicago, Ill, 1956, National Board of Fire Underwriters.
65 Lewis, S. R.: Air Conditioning, Heating and Ventilation in Hospitals, Hospitals 24:79, June, 1950.
66. Robertson, O. H., and others: The Lethal Effect of Triethylene Glycol Vapor on Airborne Bacteria, Am. J Hyg 53:69, 1951.
67. Magney, Tuster, and Setter: The Future Is Present in the Plan (112-Bed Hospital), Mod. Hosp 84:57, Jan, 1955.
68. Dale, E: Audio-Visual Methods in Teaching, New York, 1954, The Dryden Press
69. Phillips, K W: Television in Operating Room Nursing, Am. J. Nursing 2:162, Feb, 1956.

The most common disinfecting agents are chemicals, boiling water, flowing steam, and ultraviolet radiation. Bacterial disinfection may or may not be adequate for inactivation of viruses or for destruction of resistant spores and tubercle bacilli.[4, 6]

Sterile.—Absolute destruction of all living microorganisms (pathogenic or nonpathogenic, vegetative or spore forms, and inactivation of viruses). Sterilization is any process whereby all microorganisms contained in liquids, on inanimate objects, or within materials are completely destroyed.

The Council on Pharmacy and Chemistry of the American Medical Association issued a special statement on the subject:[14]

> The Council on Pharmacy and Chemistry has formally gone on record as disapproving of the use of the terms "sterile," "sterilize," and "sterilization," in a bacteriologic sense other than in their correct scientific significance; i.e., meaning the absence or destruction of all microorganisms. These terms are not relative and to permit their use in a relative sense not only is incorrect, but opens the way to abuse and misunderstanding.

Antiseptics.—Substances which, when applied to microorganisms, will render them innocuous either by killing them or preventing their growth according to the character of the preparation or the method of application—used especially for preparations applied to living tissue.[5, 15]

Germicide.—Any agent that destroys microorganisms—applied especially to chemical agents that kill disease germs, but not necessarily resistant bacterial spores. Germicides are generally used in solution form for application to living tissue or on inanimate objects.

Bactericide.—Any agent that destroys microorganisms—commonly used to kill pathogenic and nonpathogenic bacteria, but not necessarily bacterial spores The terms *fungicide, virucide, sporicide* have similar definitions.

CHEMICAL DISINFECTION

The final result of chemical disinfection of an inanimate object is absolute sterility. The process of chemical disinfection is not completely understood. In general, depending on the type of disinfection used, the vital parts of the cell (which include the enzymes) are destroyed by coagulation or blocked by combination with the chemical.[6, 8, 15] Any chemical process is influenced by the composition, solubility, ionization, and surface tension of the disinfectant when in contact with bacteria under various conditions.[1, 5, 9, 16 20]

The efficiency of a disinfectant to destroy microorganisms is influenced by many factors, including the following:

1. The selection of a disinfectant depends on the types of bacteria to be destroyed Some bacteria are more susceptible to agents than others For practical purposes in the use of chemical disinfection, bacteria may be classified in three groups: (a) the vegetative bacteria, such as the staphylococci, which are susceptible to many chemicals; (b) the more resistant vegetative bacteria, such as the tubercle bacilli and Pseudomonas group, which are susceptible to certain chemicals, and (c) the bacterial spores, which are more resistant to any

trol of air-borne microorganisms in the operating room and destruction of microorganisms on equipment used for patients. When streptococci on the skin (or on instruments) enter the deeper tissues, postoperative sepsis may occur. On the other hand, when streptococci enter the tissues via the respiratory system, the patient may suffer from streptococcal pneumonia.

Bacteria will multiply with the proper degree of warmth, moisture, and food. Certain bacteria, as they grow, excrete highly toxic substances which are absorbed by the tissues and chemical substances in the body and then are circulated throughout. Such toxins are called exotoxins. *Bacillus tetani (Clostridium tetani)*, which can cause tetanus, forms this type of poison. Other bacteria store toxic substances within themselves. These toxins are liberated only when the organisms die or disintegrate. These bacteria, such as staphylococci and streptococci, are called endotoxins.

In establishing methods of disinfection and sterilization, it is necessary to realize that there is not only a difference of virulence among specific types of bacteria, but also a difference of virulence between the strains of the same type of organism under various conditions.[9, 10] For this reason the method selected should be based on reliable experimental data.

The size and motility of bacteria influence bacterial control; however, many are nonmotile. Even though some species of bacteria have different rates of motility, they cannot crawl on a dry surface or fly through the air. They are moved by the air currents set up in the room. The smaller the bacteria, the longer they live, the longer time spent in the air, the shorter time spent on an object. Patients and workers may harbor pathogenic bacteria and not become infected with the disease. These persons are called carriers.[9, 10]

Bacteria may spread by direct or indirect contact and cause disease in another person or cause postoperative sepsis.[11] When instruments, liquids, or inanimate objects come in contact with bacteria, they are known to be contaminates. If bacteria are transferred to the patient's tissues by means of instruments or other objects and sepsis occurs, the items are known to be agents of the infection.

Knowing the types of bacteria which can cause sepsis and using processes (chemical or physical) which will destroy the resistant bacteria enables the hospital personnel to provide for a safe, clean environment and to provide sterile pieces of equipment for use in patients.[5, 12, 13]

DEFINITION OF TERMS

Certain words are used to describe antibacterial agents (physical and chemical) and their process. Accepted words, which are described in the medical and scientific literature, should be used by hospital personnel.[4, 5, 14]

Disinfection.—Any process (chemical or physical) by which pathogenic agents or disease-producing microbes are destroyed. This process may be used to destroy infectious agents but not necessarily the resistant bacterial spores.[5] Disinfectants are agents commonly used where the complete elimination of an infectious agent is required, such as in the care of utensils or other inanimate objects used by a patient with a contagious disease, and on surfaces of walls, furniture, and floors, where bacteria exist.[5]

general use, authorities suggest 5 minute immersion of the contaminated object in 70 to 95 per cent isopropyl alcohol or a formaldehyde and alcohol solution, or 15 minutes in an iodine-nonionic detergent (2 per cent Amphyl).[4, 6, 20] To destroy vegetative bacteria, tubercle bacilli, and spores, hinged instruments which cannot be exposed to heat sterilization should be cleaned thoroughly, using an iodophor solution (2 per cent solution of Amphyl or O-syl, or Wescodyne, 450 ppm raw iodine) to prevent the transfer of bacteria, and then rinsed in tap water and immersed for at least 8 hours in a strong germicide, such as an 8 per cent concentration of formaldehyde and 70 per cent isopropyl alcohol.[5, 6, 20]

BACTERIAL DESTRUCTION BY EXPOSURE TO HEAT

The Process and Use of Pressure Steam

There are several theories on how heat destroys all living microorganisms. Most authorities, however, believe that the process by which moist heat destroys bacteria is one of altering the original state of the organism and coagulating the essential proteins.

The death rate of bacteria exposed to a sterilizing medium follows an orderly, consistent pattern. The thermal death time refers to the shortest time needed to destroy all bacteria in a given medium at a given time. Because scientific tests have proved that different types of bacteria and viruses require different time-temperature rates, textiles, liquids, and utensils must be prepared and sterilized, using methods based on reliable experimental data.[4, 5, 21]

According to Perkins and others, the advantages of pressure steam sterilization include (1) rapid heating power and rapid penetration of materials; (2) destruction of most resistant nonpathogenic and pathogenic spores in a short period of exposure; (3) characteristics and power easily controlled for all packages in the sterilizer; (4) automatic controls practically excluding human error in operation; (5) accurate measures to test efficiency of the method used.[4, 21]

The limitations of pressure steam include (1) inadequate air elimination from sterilizer which decreases temperature and prevents complete permeation of contents in sterilizer; (2) incorrect operation which results in the formation of superheated steam, thus decreasing bactericidal power and damaging the material; (3) unsuitability for sterilization of greases, anhydrous oils, and powders.[7, 17, 21]

Preparation and Sterilization of Operating Room Packs by Pressure Steam

In most hospitals the responsibility for the preparation and sterilization of sterile goods for use in the operating rooms is delegated to the central supply service. The operating room nursing personnel, however, should be familiar with these procedures so that they can evaluate present procedures or carry them out in an emergency. Step-by-step descriptions of each procedure should be in writing, with accompanying illustrations, and they should be kept in a *card file.* *The* operating room nursing staff should review the latest reliable methods described in standard textbooks on this subject. (Fig. 2.)

chemical agent.[6, 15] Chemical agents are used to destroy spores only as the best available substitute for saturated steam or dry-heat sterilization. Spaulding also states that disinfectants cannot be depended upon to kill spores on large surfaces, such as floors, and walls, and also, the sporicidal agents are volatile, and the nonvolatile ones do not kill spores.[6, 15]

2. The surface of the objects must be free of blood, pus, oil, or grease, so that the chemical agent can contact the bacterial cell. The instrument or the surface of an object must be thoroughly cleansed, using a detergent and tap water or a chemical agent. Catheters and tubing should be flushed thoroughly with a suitable disinfectant, rinsed with tap water, and immersed in the solution.[4, 7, 20]

3. The time required to destroy bacteria is influenced by the types of bacteria to be destroyed, and the construction and design of the item. Death follows an orderly process, depending on the exposure period and the concentration Hinged instruments always require a longer exposure period than those with flat surfaces.[4, 15]

4. The concentration of a solution usually influences the efficiency of the agent. A weak solution is not as effective as a strong solution of the same chemical, except for ethyl alcohol.[15] A 70 to 80 per cent solution of aqueous isopropyl or ethyl alcohol has more germicidal power than absolute alcohol.[5, 18] The concentration of any disinfectant to be used for a specific object should be based on relevant experimental data.[16] A correct concentration prevents waste and safeguards living tissue or the object when in contact with the agent.

5. An increased temperature accelerates the rate of disinfection. This fact has only a practical value when disinfecting inanimate objects. Germicidal efficiency is increased when the chemical agent is added to hot or boiling water.[10]

6. The action of most chemical agents is considerably decreased in the presence of organic materials, such as blood, pus, body fluids, and mucus. Hospital personnel should use chemicals which have been tested. The official phenol coefficient method is suggested, as this retains at least 50 per cent of its germicidal power in the presence of organic materials. Studies show that there are not only differences in the disinfection time to destroy various types of bacteria, but also that this time is extended when the bacteria are placed in media of blood.[15] When body fluids are allowed to dry on the surfaces, the fluid forms a protein coating around the bacteria, thus creating a mechanical barrier.[1, 2, 5]

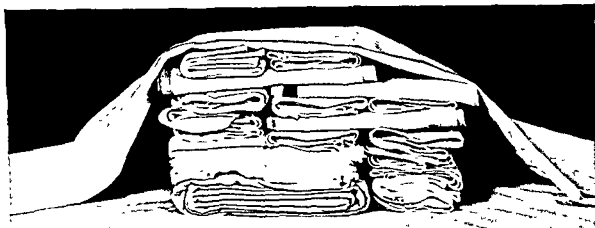
7. The composition and structure of the object or instrument will influence the kind of chemical to be used and the time the object can be exposed to the agent. The hospital staff should review the standard textbooks when selecting the agent. Several chemical agents may be used to destroy vegetative and tubercle bacilli on inanimate objects, such as delicate, hinged, flat, or lensed instruments, or on catheters and tubing which cannot be exposed to heat sterilization, and on small areas on walls, floors, and furniture.[8, 11, 15]

8. The *surface tension (wetness) of a chemical agent promotes contact* between the agent and microorganisms. A tension-reductant chemical, when combined with other chemicals, enhances the disinfecting power of that solution. A good general disinfectant should destroy vegetative and tubercle bacilli in 10 minutes at room temperature. To destroy vegetative and tubercle bacilli for

Size and Number of Packs.—Since the movement of air and steam passing in and out of each pack and in the chamber of the sterilizer depends on gravity, the largest pack should measure approximately 12 by 12 by 20 inches.[4] Large, dense packs require a long exposure period; thus the outer layers of goods and the entire small packs are oversterilized. (Fig. 3.)

Various kinds of packs must be prepared each day to meet the patients' needs. A standard yearly inventory of textiles must include those sterile, those

Fig 3.



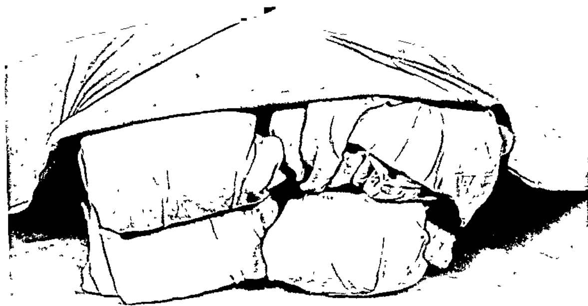


Fig 4.

Fig. 3—The textiles to be used in major surgery are arranged ready to be wrapped in a muslin cover. Alternate layers of goods are placed crosswise to promote steam permeation A table sheet is folded once and is lying flat on the table, to be used as inner covering of the pack This provides a convenient way of draping the instrument table when the pack is opened. The pack is covered with table sheet, then the entire pack is wrapped in a two-thickness muslin cover and held in place with cord or pressure-sensitive tape (From Perkins, J J: Principles and Methods of Sterilization, Springfield, Ill., 1956, Charles C Thomas, Publisher)

Fig 4—Gowns may be wrapped in units of four, with muslin covers as shown (From Perkins, J J: Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

The method of assembling, wrapping, loading, and storing materials (sheets, towels, and gauze materials) must not hinder the escape of air or the entrance of heat and steam to the contents of the packaged material. The procedure must conserve costs and preserve the composition of the textile or object.

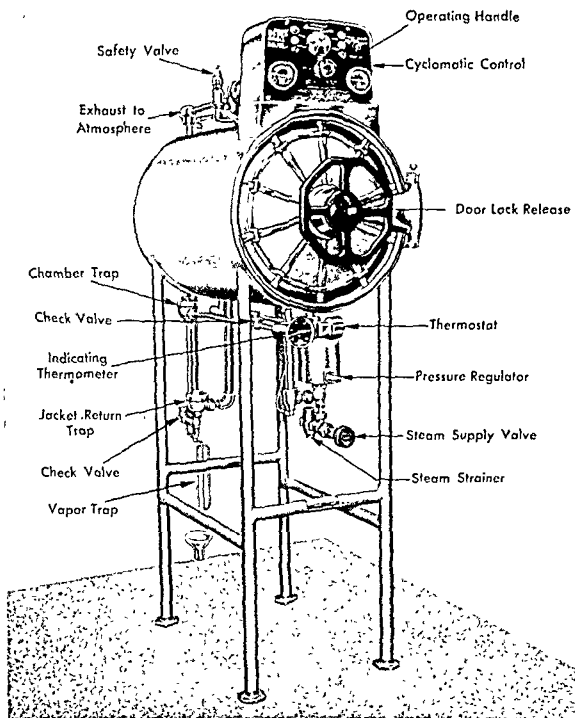
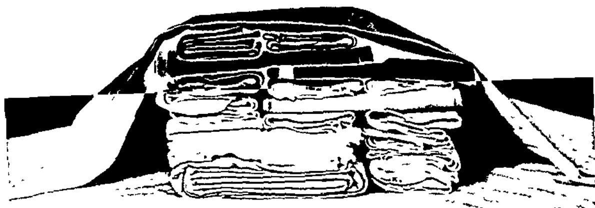


Fig 2 —Direct steam-heated sterilizer (From Perkins, J J Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

Size and Number of Packs.—Since the movement of air and steam passing in and out of each pack and in the chamber of the sterilizer depends on gravity, the largest pack should measure approximately 12 by 12 by 20 inches.[4] Large, dense packs require a long exposure period; thus the outer layers of goods and the entire small packs are oversterilized. (Fig. 3.)

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Fig. 3.



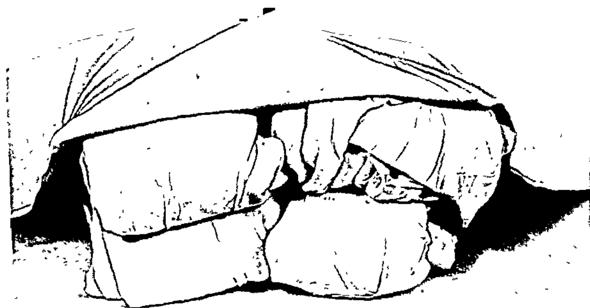


Fig 4

Fig 3—The textiles to be used in major surgery are arranged ready to be wrapped in a muslin cover Alternate layers of goods are placed crosswise to promote steam permeation. A table sheet is folded once and is lying flat on the table, to be used as inner covering of the pack. This provides a convenient way of draping the instrument table when the pack is opened The pack is covered with table sheet; then the entire pack is wrapped in a two-thickness muslin cover and held in place with cord or pressure-sensitive tape. (From Perkins, J J: Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

Fig 4—Gowns may be wrapped in units of four, with muslin covers as shown. (From Perkins, J J Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

in the process of preparation, and those in the laundry. The contents of each *different type of pack must be suitable to specific operations.* (Chapter 4.) Fanned and folded plain sheets and fenestrated sheets should be wrapped separately because such fabrics are difficult to sterilize (Fig. 4). Textiles should not be packaged with basins or other types of containers, because they offer resistance to steam permeation and retard the drying process of the textiles after sterilization. Dry goods should not be sterilized in the same load with the instrument sets.

The cover must protect the textile or object from contamination encountered during handling and storage, allow free passage of steam, and act as a dust filter of room air. Dust may enter the outer covering of a freshly sterilized pack as the water vapor condenses due to contact with outside air. This condensing process creates a slight vacuum within the pack whereby the room air is drawn into the outer cover.[4, 21-24]

At present the best kind of cover consists of two thicknesses of a good quality of muslin which is large enough to overlap and provide four thicknesses of muslin over the textiles. Two thicknesses of muslin decrease the danger of contamination due to minute holes in the cover. Worn-thin covers should not be used because they are not good dust filters. Because heavy or tightly woven materials, such as canvas, resist steam, they should not be used as covers or draping sheets.[21-25] *Muslin covers may be made in the hospital or may be purchased.* To prevent transmission of bacteria, there should be a sufficient supply of covers so that all packs can be wrapped in freshly laundered ones. The outer cover and contents of the pack should be secured with cord size 1 or pressure-sensitive tape. Pins should not be used as they make holes in the muslin and also create a hazard if they protrude outside the cover after their insertion.

Drums are not considered a safe or efficient type of cover. They restrict the escape of air and the intake of steam; and their covers and openings admit room air and dust. The drums also help to create a noisy environment, increase costs due to initial expense of drums and their racks, and require extra handling and a long-time exposure. If drums are to be used, the folded contents must be loosely arranged within a two-thickness muslin cover which should line the interior surfaces of the drum. The contents must not rest against the inner side of the drum.

Assembling Textiles in Packs.—All dry textiles, such as sheets, towels, and pads (which have been exposed to dry air for several days) must be hydrated by spraying them with distilled water before packaging This residual moisture is required to prevent extracting additional moisture from the steam during the sterilizing process. In sterilizing fabrics low in initial moisture content, more latent heat is released so that the temperature of the sheets is higher than that of the surrounding steam at the same pressure. Superheating of fabrics also destroys their tensile strength.

Sheets and gowns should be folded loosely and arranged in a pack in such a way as to provide for free passage of air and steam and facilitate easy handling in surgery. Steps in preparing packs for sterilization are described in standard textbooks on this subject.[4]

Loading of Packs and *Sterilization Period.*–The worker should carry out the instructions and rules prepared by the manufacturer of the sterilizer. The time required to destroy all living microorganisms depends on the size of the largest pack in the load. Perkins states that if the packs are arranged properly, it does not matter how many packages are in the load, but the larger packages necessitate an increase in the time required for the thermometer to indicate the desired temperature.[4] The temperature rises more slowly in the presence of twenty packs than in the presence of a few. Packs of correct density should be exposed to saturated steam at 250° F. for 30 minutes.[4, 17, 23] Drums should be exposed to this temperature for at least 45 minutes.[17]

Drying and Storing of Sterile Packs.–The packs are dried, usually by exhausting the steam from the chamber to zero gauge pressure, then leaving the jacket pressure on so that heat is retained in the chamber. When the sterilizer door is opened and left slightly ajar to permit vapor to escape, the packs should dry in about 15 miuutes, or the vacuum method may be used, thus preventing the escape of vapor into the room.

To protect damp sterile packages from contamination, they should not be placed on cold unsterile surfaces. If sweating occurs, the package may reabsorb the unsterile water on the table. The sterile packs should not be stacked closely, but should be left in the loading carriage for 15 to 20 minutes. They should be placed on clean open shelves located in a scrupulously clean, dry, vermin-free room. The door of this room should be kept closed when not in use. Packages should be handled carefully, and when they are taken to the operating rooms, they should not be left on tables in areas where they will be exposed to many air-borne bacteria and to dust.

A sterile pack on a shelf is usually considered to be sterile for a one- or two-month period. If a weekly inventory is correctly determined, few packages become outdated.

Cleaning and Sterilization of Instruments

The sterilization facilities for operating room units have been described in Chapter 1. The method for cleansing and sterilizing instruments and basins depends on the properties of the equipment, type of soil, types of bacteria, and facilities available.

Manual Washing of Instruments.–Soiled instruments must be cleaned as soon as possible to remove blood and other substances before their surfaces have an opportunity to dry. If instruments cannot be washed immediately, they should be submerged in a warm detergent solution, such as Calgonite or Tide. Abrasive compounds should never be used.[18, 19, 22]

To wash soiled instruments manually, the following steps should be observed:

1. Release all catches or joints of instruments and open-hinged instruments.
2. Place instruments in deep basin or tray and cover them with water at 125° F. Add an effective detergent, which will aid in loosening fats, minerals, dried blood, and other substances. The type of detergent to be selected is influenced by the hardness of the water supply.

3. Soak instruments 10 to 45 minutes, depending on the kind and amount of soil and the composition of the instruments.

4. Scrub instruments, using a hand brush with fairly stiff bristles.

5. Drain off detergent solution; then immerse instruments for a few minutes in boiling water.

6. Dry instruments at once. Inspect, and return them to trays or storage.[4, 7, 18]

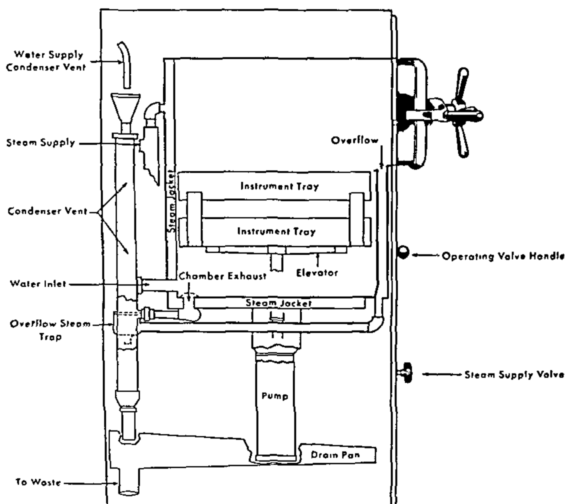


Fig 5—Longitudinal diagram of pressure instrument washer-sterilizer, horizontal type (From Perkins, J J. Principles and Methods of Sterilization, Springfield, Ill., 1956, Charles C Thomas, Publisher)

Mechanical Washing and Sterilization of Instruments.—The horizontal-type pressure instrument washer-sterilizer (cabinet design) can be used to wash soiled instruments and sterilize them after a clean or septic case, or to sterilize clean instruments for surgery (Fig. 5) When this sterilizer is used, the instruments are cleaned with the aid of a mechanically agitated water bath containing a detergent. The water is removed from the sterilizer and the instruments sterilized

for 3 minutes at 270° F. This sterilizer helps to control the spread of bacteria, reduces labor costs, and conserves time.

The efficiency of the process depends on the kind of foreign material present and the number of instruments in the load (Fig. 6). Complete removal of all soil from the serrations and crevices of instruments depends on the construction of the instrument, the time of exposure, the pH, and the efficiency of the detergent solution. If hard water or water with a high mineral content is used, it usually leaves a powdered deposit on the surfaces of the instruments. The use of an effective detergent helps to remedy this problem. Soiled grooved instruments, such as the von Petz anastomosis clamp and Payr and blood vessel clamps or scissors, should be soaked immediately in detergent-germicide to prevent excessive drying of soil; and they should be sterilized as soon as possible in the pressure instrument washer-sterilizer. The worker should follow the operational instructions prepared by the manufacturer of the sterilizer being used.

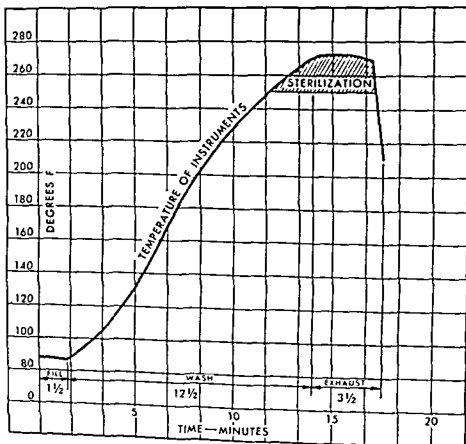


Fig 6.—Process chart showing time required and resulting temperature of the instruments during each phase of the washing-sterilizing cycle (From Perkins, J J: Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

Preparation and Sterilization of Instruments With Saturated Steam.—All instruments must be thoroughly cleaned manually or mechanically before they are arranged in the tray and prepared for sterilization.

The steps of the procedure are as follows:

1. Place an instrument tray with a perforated bottom on a table near the clean instruments on the rack.

2. Place one layer of muslin in the bottom of the tray.

3. Place instruments in tray, unlocking and opening all jointed instruments to permit steam to contact all surfaces; arrange all instruments in such a way as to facilitate the work of the scrubbed nurse, thus eliminating the need to arrange them later.

4. To store or transport sterile trays a distance, wrap each tray in a muslin cover, secure with cord, and send them to be sterilized.

Instrument trays which are wrapped in muslin covers are exposed to saturated steam at 250° F. for 20 minutes, and unwrapped instrument setups are sterilized for 15 minutes. After completion of the sterilization cycle, open the sterilizer door slightly, and allow the wrapped instruments to dry for 10 to 15 minutes.[4, 17, 23]

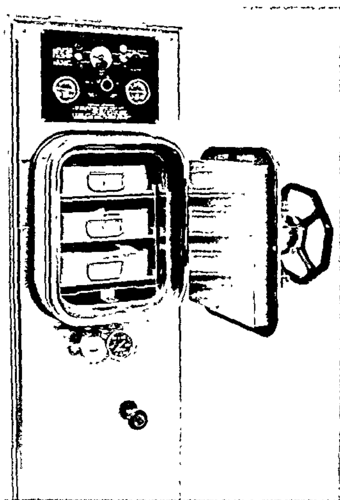


Fig 7.—High-speed pressure instrument sterilizer, adjusted for operation at 270° F., meets the requirements for either emergency or routine sterilization. (From Perkins, J J: Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

Sterilization of Instruments in High-Speed Pressure Sterilizer.—The clean instruments are arranged in a perforated tray as described previously. The high-speed sterilizer is preheated. The steam should always be maintained

in the jacket before and during the entire sterilizing cycle (Fig. 7). After the steam has entered the chamber, the exposure period of 3 minutes is noted when the thermometer indicates 270° F. The worker must follow the instructions prepared by the manufacturer of the sterilizer.[4]

The sterilizing cycle of all steam sterilizers is based on the same principle. Since the heat and moisture come in contact with only the surfaces of the instruments, the cold metal condenses the steam until the instruments are heated to the temperature of the steam. The instruments are actually bathed in the moisture. A shorter period of exposure is required for instruments or utensils than for fabrics, because the heat and moisture do not penetrate their surfaces.

Sterilization of Basin Sets With Saturated Steam.—The standard basin sets required for various operations *should be thoroughly scrubbed with a detergent* solution, dried, and then wrapped in two thicknesses of muslin. Basins of the same dimensions (nested) should be separated by a piece of muslin to allow space for the steam to contact all surfaces. When the basin sets are loaded in *the sterilizer, they must rest on their edge to facilitate sterilization and drying.* When basin sets are sterilized in the substerilizing unit adjacent to the operating room unit. They needed not be wrapped in muslin. They must be arranged in the sterilizer so that the steam will contact all surfaces. Sets should be exposed 15 minutes to saturated steam at 250° F. When they are to be sterilized with dry goods, the basin sets are placed at the front or back of the load. They should not be placed on the top or below packs.[4] After sterilization, the basin sets are usually stored on shelves near the sterile packs.

Sterilization of Nonpackaged (Unsterile) Nonabsorbable Sutures.—When many yards of silk, cotton, or nylon material are purchased on spools, one to three yards should be loosely wound onto a holder, such as a small piece of rubber tubing or a metal spool, or it should be coiled and placed in the folds of a gauze sponge, wrapped in muslin, and sterilized in steam pressure at 250° F. for 30 minutes. *Nonabsorbable sutures should always be sprayed lightly with water* just prior to sterilization, thereby preventing superheating which will destroy their tensile strength. In an emergency a few strands may be sterilized by direct contact with steam and heat in the high-speed sterilizer.

To make a rubber suture holder, take a piece of clean rubber tubing about 2½ inches long and one-half inch in diameter. Make a small slit in each end (opposite each other). Write the size of the material (using a ball-point pen) on a small piece of resistant tape and adhere it to the holder near one end. Take a length of suture and secure one end onto one slit; then loosely wind the strand around the center portion of the holder, securing the free end of the strand in the other slit; wrap the holder in muslin, mark the package, and send to be sterilized.

Nonabsorbable sutures threaded on needles may be inserted through a strip of gauze, *then wrapped in muslin*, and sterilized. Cotton should not be wound over wooden material since it may contaminate the cotton. Its tensile strength will also be reduced since cotton shrinks in the *presence of moist heat.*

Sterilizing Outside of Suture Packages.—Some sterile sutures are purchased in exterior sterile envelopes stored within a hermetically sealed jar containing

2. Place one layer of muslin in the bottom of the tray.

3. Place instruments in tray, unlocking and opening all jointed instruments to permit steam to contact all surfaces; arrange all instruments in such a way as to facilitate the work of the scrubbed nurse, thus eliminating the need to arrange them later.

4. To store or transport sterile trays a distance, wrap each tray in a muslin cover, secure with cord, and send them to be sterilized.

Instrument trays which are wrapped in muslin covers are exposed to saturated steam at 250° F. for 20 minutes, and unwrapped instrument setups are sterilized for 15 minutes. After completion of the sterilization cycle, open the sterilizer door slightly, and allow the wrapped instruments to dry for 10 to 15 minutes.[4, 17, 23]

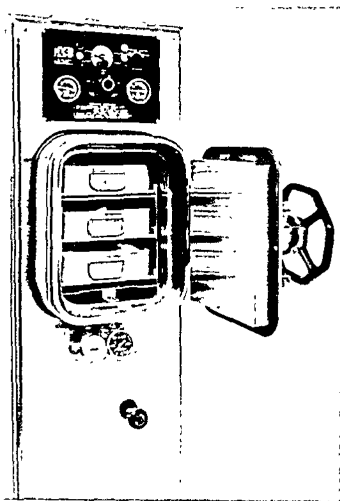
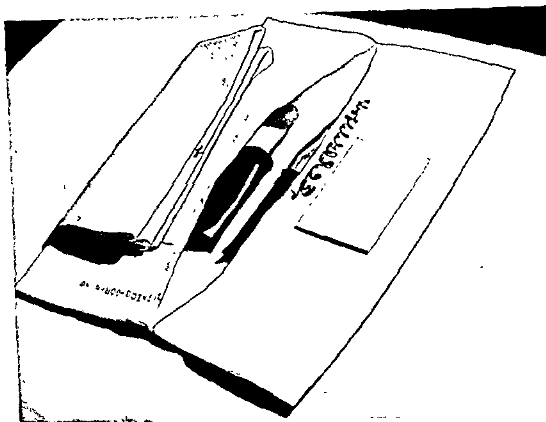


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Sterilization of Instruments in High-Speed Pressure Sterilizer.—The clean instruments are arranged in a perforated tray as described previously. The high-speed sterilizer is preheated. The steam should always be maintained

Fig. 8.



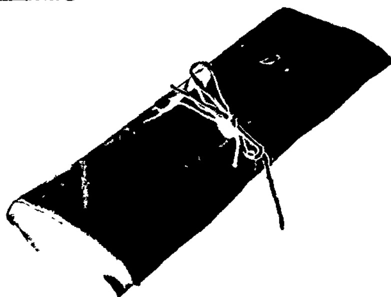


Fig. 9.

Fig 8.—Billfold-type muslin cover commonly used for wrapping gloves The paired gloves are inserted, with thumbs up, into pockets of the muslin envelope A small quantity of powder (Biosorb) in a small steam-permeable paper envelope or in a gauze sponge can be included as shown (From Perkins, J. J: Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher)

Fig 9.—The envelope shown in Fig 8 should be wrapped in this manner The outer covering is designed for the purpose and includes tie strings (From Perkins, J J: *Principles and Methods of Sterilization*, Springfield, Ill, 1956, Charles C Thomas, Publisher)

an alcoholic germicide. Since the storage fluid does not contain formaldehyde or an agent known to destroy resistant spores in a few hours, the contaminated inner surfaces of the jars and their covers must be resterilized by heat sterilization before they are refilled with the prescribed storage fluid and the contaminated envelopes replaced. The exterior of the envelope and the inner surface of the jar may be exposed to the alcoholic germicide for 30 minutes to destroy vegetative bacteria, including tubercle bacilli. The time exposure depends on the numbers and types of bacteria present. If the grossly contaminated plastic envelopes with sutures will not withstand a long exposure period in a strong germicide, they should be discarded in the incinerator, because the agent may penetrate the sterile suture (Chapter 5).

Cleaning and Sterilization of Catheters and Rubber Tubing With Steam Under Pressure.—Catheters made of rubber or latex must be cleansed with an alkaline detergent, such as trisodium phosphate, and rinsed thoroughly with tap water [7] Cleansing agents which contain oxidizing acids, hydrocarbon solvents, or oils should not be used since they have a deteriorating effect on such items.

Woven catheters with a synthetic resinous coating should be washed with a nonalkaline solution, such as a mild soap solution and water. The lumens of the catheters should be flushed with the agent and then with tap water and air, using a syringe and needle.

Dry rubber or latex catheters or rubber drainage tubing should be moistened with tap water prior to sterilization to prevent deterioration due to superheating. Catheters and drains used in surgery should be wrapped in muslin. An opened gauze sponge (4 by 4 inches) should be wrapped around the catheter under its head or wing to prevent flattening. Catheter stylets should be individually wrapped.[18, 25, 26]

When a catheter is packaged in cellophane tubing, the lumen of the catheter is flushed with tap water; then the catheter is passed through a piece of cellophane tubing of the correct width and length. The end of the tubing through which the catheter will be withdrawn is folded over and clipped. Its other end is left open and closed after sterilization. Woven catheters, bougies, and filiforms should be fairly free of moisture, and should be kept straight and wrapped in muslin.

Nylon, rubber, and latex catheters, as well as woven catheters and bougies, should be exposed to saturated steam at 250° F. for 15 minutes.[4, 7, 8, 26]

Disinfecting Equipment by Boiling Water (Atmospheric Pressure).—Since boiling water is not a sterilizing agent, it should only be used in emergencies and for sanitizing equipment Because the temperature of boiling water is controlled by atmospheric pressure, it is not a constant figure and varies with the elevation above sea level and from day to day. At sea level the boiling water reaches a temperature of 212° F., but decreases at high altitudes almost 2° F., for each 1,000 feet of elevation. For this reason, equipment at high altitudes must be exposed to boiling water for longer periods of time. In places which are above sea level, a pressure cooker may be used in emergencies.

Handling and Sterilization of Rubber Gloves.—The cleaning procedure aims to prolong the life of gloves, reduce labor costs, and prevent the transmis-

Culture Tests to Determine Sterility of Instruments and Textiles

The culture test is the best direct approach to the lethality of the sterilizing process. To test the sterility of the linen package in a load (or the instruments), it is best to use an envelope containing a testing medium, such as spore strips.[4] Two strips should be placed in the center of several of the largest packs, or in the jaws of heavy forceps, one situated at the front end of the tray and the other in the center. The packs should be marked and placed at the edge of the bottom shelf of the chamber near the front end of the sterilizer. Other packages may be placed in the sterilizer in the usual manner. After completion of the sterilizing cycle, the strips should be removed from each test pack placed in an envelope and delivered to the laboratory for sterility testing. Such tests should be carried out once a month.

CONTROLLING AIR-BORNE MICROORGANISMS

Gross dust pollution in operating rooms and in patients' units can be eliminated if sanitary procedures are carried out. The different patterns of germ-laden dust, as well as the dynamic patterns of droplet nuclei, have been studied for centuries.[11, 27-37] Although authorities now agree that air is a natural means through which disease-producing bacteria are transmitted, the real significance of sanitary ventilation is not yet fully understood.[29] However, there are many procedures which the hospital personnel can carry out to control postoperative sepsis and cross-infections.[31, 32, 34, 36-45]

Factors Related to Wound Infections

Infection as well as contamination may be air-borne. In hospitals, pathogenic bacteria, such as tubercle baccilli, staphylococci, streptococci, enterococci, and Pseudomonas bacilli, are found in cultures collected from the air, on pieces of equipment, from materials such as soiled clothing and shoes, and from dust on the floor.[28-32] (Fig. 10.)

A large percentage of air-borne infections are due to the following sequence of events:

1. The patients, workers, and visitors inject the small infected droplets into the air.

2. The droplets in the dust particles are transmitted to other persons through the air.

3. Heavy concentrations of infected dust particles settle on surfaces of the equipment, materials, and floor.

4. The activity of the personnel mobilizes these dust-infected particles so that the air becomes contaminated.

5. In a poorly ventilated room the bacteria are distributed from one area to another.

6. The bacteria settle out of the air into the open wound, thus producing sepsis, especially in the presence of foreign bodies or devitalized tissues.

sion of bacteria[4, 7, 20, 25] The worker should rinse and wash his soiled gloves in cold or lukewarm water before removing them. Grossly contaminated gloves should be discarded. All soiled gloves should be placed in a special bag designated for this purpose. Soiled gloves should be sent to the laundry at once and should not be allowed to accumulate in the rooms. When cleaning gloves, the worker should follow the step-by-step instructions which have been prepared by the glove manufacturer. After the gloves have been washed, dried, tested, powdered, and turned, they are placed in a muslin envelope in such a way as to provide for proper penetration of steam. The envelope is wrapped in a muslin cover and sterilized with steam under pressure at 250° F. for 15 minutes (Figs. 8 and 9).

The Process and Use of Dry-Heat Sterilization

Hot air destroys microorganisms by means of oxidation. Substances such as anhydrous oils, grease, and powder, which have practically no water content through which the moisture of saturated steam can penetrate, are best sterilized by dry heat. When anhydrous materials are exposed to steam under pressure, they are only heated to the surrounding temperature of the steam (250°F.); thus the bacteria may only become dehydrated by the heat. The properties and function of syringes are more readily preserved with dry heat than with steam under pressure.[4, 17, 23]

The exposure period required to destroy bacteria in or on such items depends on the type of substance, the surface area exposed to the hot air, and the types of bacteria present. Most materials and instruments can be sterilized by exposure to hot air in a mechanical connection hot-air oven, at 320° F. for 120 minutes. The manufacturer of such sterilizers should be consulted when determining exposure time for specific materials or objects.[4] The exposure period, using the autoclave as a dry-heat sterilizer, is six hours or more.

The Use and Dangers of Water Sterilizers

Nonpressure water tanks in the operating room units present several dangers. The water will not remain sterile after sterilization for 30 minutes at 250° F. and the filter will only keep the tank free of gross soil. When the water is removed, a corresponding amount of air is sucked into the tank due to the existing negative pressure. Sterile distilled water stored in sterile flasks should be used unless the units are equipped with pressure water tanks. Such tanks, however, also present certain hazards. When the air contains bacteria, the water may become contaminated, depending upon the efficiency of the air filter. The water in a leaky valve will also contaminate the water in the tank.[4]

Sterile water in automatic controlled-pressure tanks must never be used in the preparation of parenteral solutions or in procedures where the physiologic condition of the body must be maintained. Sterile water in pressure tanks should be used only for rinsing gloved hands, irrigating wounds, and wetting gauze packs

Practical Methods to Control Contaminants

There is a serious problem in hospitals which the operating room staff should recognize. This problem is how to prevent patients from acquiring infections. Air contamination can be controlled by preventing the outside dust from entering the operating rooms and by arresting the dust that is present or generated within the room.

Housekeeping.—Scientific housekeeping is still the most important way to prevent air-borne infections.[41-45] Good housekeeping rules include the following:

1. Suppress the formation and dispersion of dust.
2. Allow time for dust to precipitate and settle.
3. Detect the degree of contamination harboring on the objects, in the air, and in the personnel by means of suitable periodic cultures.
4. Prevent dust and soiled laundry from accumulating.
5. Expose dust deposits to mild bactericidal radiation (sunlight, artificial rays, or chemicals).
6. Provide proper ventilation for recirculation of pure air, and install adequate cleaning devices, such as filters and washers.
7. Set up maintenance and safety measures.
8. Follow a systematic housekeeping plan which has been clearly defined by the nursing service and the maintenance department.[13, 19, 45-47, 49]

Cleansing Equipment and Rooms.—During and between operations, air-borne contaminants can be reduced by keeping pieces of suture material, glass particles, bloody sponges, and pus off the floor. The contaminated areas of the floor, wall, or furniture should be wiped immediately with a germicide, such as an iodophor 2 per cent solution (Amphyl), or a 95 per cent isopropyl alcohol.[42-50]

Upon completion of a "clean" operation, the suction bottle and tubing and the kick-buckets should be washed and flushed with an adequate detergent such as Tide, or a 1:500 solution of sodium hypochlorite, or a 2 per cent solution of Amphyl. The floor should be damp-mopped with a detergent and hot water.[13, 18, 52] Terminal disinfection is described later in this chapter.

Final general cleaning of the furniture, light fixtures, cabinets, and floor of each room is usually done in the evening between 3:30 P.M. and midnight, and on Saturdays. After a room has been thoroughly cleaned, it should not be used for at least three hours so that the remaining bacteria will have time to settle.

The floor, walls, window sills, and ventilators should be vacuumed. Pieces of suture material and dirt should be removed from the casters on the furniture. All movable pieces of equipment, such as tables, stools, and stands, and soiled areas of the walls, ventilators, and shelves of cabinets should be scrubbed, using a detergent and warm water. Stains on floors should be covered with cold water, and the puddle wiped up by starting at its rim and working toward the center.[44]

An efficient method of scrubbing floors meets several objectives: (1) removes large concentrations of air-borne parasites, (2) prevents an accumulation of non-

Air-borne, germ-laden dust particles are formed by "wearing away" from solid materials and fabrics. These transitory parasites spend most of their time waiting to be moved into the air. They float in cloud formations and their time of suspension is limited by their settling velocity. Studies show that in a closed room, with a 60 per cent relative humidity, the air is clean after six to eight hours because the dust-infected particles have settled out onto the furniture and floor.[29, 33, 34] *The air remains clean until the bacteria are moved into the air due* to the activity of the workers. The large dust particles carry more bacteria, usually of the saprophytic type, than droplets or droplet nuclei do. About 90 per cent of the ejected droplets fall onto the nearest horizontal surface within a few minutes, to mix with the accumulated dust, or fall into the open wound.[35]

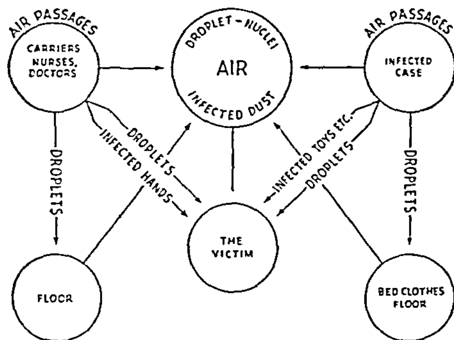


Fig. 10.—Diagram showing how infections may be accidentally spread in hospitals. (From Medical Research Council War Memorandum No. 11. Reproduced by permission of the Comptroller of His Britannic Majesty's Stationery Office.)

A relative humidity of 60 to 70 per cent has a practical bactericidal effect on air-borne bacteria. Sodium chloride in the air has some lethal effect also on the microorganisms that are freed as the droplets evaporate.[29, 36, 37]

Disinfection and Radiation of Air

Studies indicate that air-borne bacteria can be destroyed in several minutes by the vapor molecules of propylene glycol and triethylene glycol, the halogens, hypochlorites, and hexylresorcinol solution; however, engineering problems must be solved before they can be used effectively for providing a sterile atmosphere.[12, 19, 25-40]

Irradiation disinfection of air with ultraviolet light has been used to purify the air and to control cross-infection under controlled conditions.[37, 38] The disadvantages of ultraviolet rays have been discussed previously in Chapter I.

To reduce the amount of dust and lint dispersed when linens are being handled, an oily emulsion may be added to the first rinsing water during the laundering process and a quaternary ammonium solution added to the final rinsing water to make the fabrics actively bacteriostatic.[18, 54, 56] The soiled draping sheets and towels should be kept away from main corridors and those areas where sterile packs and clean items are stored. When personnel handle contaminated linen, they may wear washable gloves, and should wash their hands thoroughly with a detergent after discarding the gloves in the laundry chute.

PROVIDING SAFETY AND COMFORT FOR PATIENTS AND PERSONNEL

All operating room personnel should take part in the hospital safety program and should be prepared to carry out specific duties in caring for patients in time of natural or atomic disaster.[62, 69]

Routine safety measures include the use of warning signs in wet areas on floors and keeping movable pieces of equipment out of traffic areas. Many accidents can be prevented by keeping equipment in good working order and having trained personnel test it beforehand.[64, 65, 70, 83] Negligence and lack of knowledge on use of equipment are often causes of accidents. All newly employed personnel should be instructed, oriented, and supervised until proper use of equipment is assured.

The doctor, nurse, technician, and nursing aide each have a threefold responsibility for the safety measures.[71, 75, 78, 84] Each person should be concerned with the safety of the patient, his immediate co-workers, and himself. In accepting this responsibility, he should know how to use the fire extinguisher, how to report a fire, evacuate patients, and write a report on an accident.[71-73] The workers should follow the rules recommended by the National Fire Protection Association for operating rooms, to safeguard themselves and others from explosion hazards, electric shock, and burns. Proper clothing should be worn to reduce the explosion hazards in the operating room.[62, 80-82, 84]

At least once a month the operating room supervisor should see that rooms are made available to the engineering department to test the conductivity of the flooring and furniture. Usually, a minimum of five readings are taken, using a megohmmeter and placing the electrodes three inches apart. When a ground is used, two readings are taken from floor to ground and from ground to floor. The conductivity of equipment with the flooring should be taken by connecting one lead wire to a piece of furniture and another wire to the electrode on the floor.[50-52, 62, 63] The composition, design, electric wiring and appliances, and the scrubbing of the flooring should meet the specifications recommended by the Underwriters Fire Protection Association.[50, 58] The personnel should remember that water is a good conductor of electricity and that it must not come in contact with any electric appliances because of the danger of short circuits. When such devices are used in surgery, they must be completely insulated to reduce the danger of burns.

conductive material, and (3) prevents slipping and its consequential electrostatic potentialities as well as injury to personnel.[22]

The floor should be scrubbed thoroughly with a disinfectant, such as sodium hypochlorite, and warm water. After the soil has been dissolved, more solution should be applied and removed by means of a wet pick-up vacuum. The floor should be rinsed thoroughly to prevent a detergent mist from forming on it, since it will become loose later and redeposit soil, which will reduce the conductivity of the flooring. The floor should be allowed to dry.[13, 19, 55-58]

Additional Sanitary Measures for Controlling Contaminants.—Hoppers and toilets should have flushing rims and such receptacles must be kept scrupulously clean. Nothing should be emptied into waste pipes that will not disintegrate into small particles.[49, 50, 59]

Soiled sponges or cotton swabs and other materials contaminated by oral and nasal discharge should first be placed in a utensil; then the contents should be placed in a paper bag to be discarded in the incinerator chute or waste receptacle. Such contaminants should not be placed in kick-buckets in the room. Soiled dressings and discarded plaster casts should be placed in waxed paper bags or wrapped in several thicknesses of paper and then deposited directly into a waste can which has been lined with a large water-proof paper bag. The paper lining protects the worker's hands as he discards the material in the incinerator chute. Waste receptacles should be washed thoroughly each day with boiling water and a good disinfectant.

Sanitary disposal of excreta, pus, and drainage from wounds is of primary importance, since some of the major diseases are spread by the ingestion of excreta. After the worker has disposed of soiled dressings or waste materials, he should wash his hands and forearms with a detergent or soap.

Refuse cans should be large enough to hold soiled dressings and other refuse, and should be equipped with a top and footpedal.

The exterminating company should inspect all operating room areas at periodic intervals, especially the utility rooms and areas around plumbing fixtures. Such poisonous drugs as DDT (dichloro-diphenyl-trichloroethane), clordane, or benzene hexachloride may be used under controlled conditions. Aerosol bombs, small, thick-walled containers of volatile liquids containing insecticides under pressure, are useful in removing flies and mosquitoes.[59, 60] An insecticide, DDT 5 per cent, and Pyrethrum 0.4 per cent, which is relatively harmless to people, may be used[59] Safety measures must be carried out in those areas to prevent explosion hazards that may occur when volatile agents are being used.

Proper laundering is important to prevent the spread of bacteria on linens.[56] The patient's bedding and clothing should also be clean, and such materials should not be thrown across a room or on to the floor, or handled with great gusto by the workers. Linens and dressings should be removed gently. Upon completion of the operation, the gowned and gloved worker should remove the soiled sheets and towels from the patient and place them in the container designated for that purpose. When the patient has an infectious disease, the soiled linen should be placed in a special bag designated for this purpose. Catheters, drains, and tubes must be cleaned, as discussed previously.[4, 61]

In some hospitals pictures are painted on the walls or ceilings of the operating room units, and in some units music is recorded. Even though accoustical materials are used and pieces of movable furniture are equipped with rubber casters, there often are *noises which annoy and disturb patients*. Workers should carry out their activities as quietly as possible. A low whisper three feet away has a noise intensity of 20 decibels. (A decibel is a measurement made with reference to the minimum audible sound.) Authorities report that noise effects man physically and psychologically. (*Chapter I*). *Even though the worker's output is not* always reduced due to a moderate amount of noise, he does use more energy in trying to overcome the distracting effect.

Because many patients are aware of the activities that are taking place around them, the personnel should remember that whispering or talking loudly is irritating to others. When the apprehensive patient hears whispering, it may mean to him that his condition is unfavorable. To help reduce the patient's fears and doubts, the nurses should have all pieces of equipment ready for use before he arrives and should give him their wholehearted attention.

A patient who must wait in the operating room should be placed in the quietest area and where he cannot see the activity in another room. The patient in surgery usually has an innate desire for privacy; however, quiet, like every other therapeutic measure, must be used carefully.

Disagreeable odors in surgery have their origin in discharges from wounds and from the use of chemicals and anesthetic agents. Because safe chemical atmospheric deodorants have not been too satisfactory, physical measures are still more effective. Good housekeeping and proper air sanitation, including adequate ventilation and air-conditioning, are still the best ways to control disagreeable odors.

PERSONAL HYGIENE OF OPERATING ROOM PERSONNEL

When doctors and nurses are carrying out duties in the operating room, they should take every precaution to protect their patients from postoperative sepsis. The worker should not neglect any safety measure in an effort to improve his or her own personal appearance or to conserve time.

All personnel must be scrupulously careful about their persons. To avoid transmitting organisms directly or indirectly to patients, they should keep their hair and scalp clean, and should not touch their hair when they are working. They should keep their fingernails short so that bacterial flora can be removed readily. Long fingernails also tend to rupture the fingers of the person's sterile gloves. The worker should always dry his hands after washing them, and at the end of the day and at bedtime, he should apply a "barrier" cream.

The physical fitness and happiness of the staff also play an important part in providing efficient service. Personnel should not be assigned to the care of patients for a long time without a short relief period. Workers should have taken an adequate amount of food and fluids prior to starting their assignments. Fatigue and indisposition often lead to irritability, and, in turn, inefficiency of work performance may result from tension

When transporting patients to and from the patients' units to the operating room, the worker should follow the rules defined in the hospital policy manual. Restraints should be attached to the vehicle in such a way as to prevent the patient from falling off or getting off and yet not restrain normal functioning of the body.[65, 66] In some hospitals, infants are transported from one department to another in a basket-type vehicle on wheels. Infants and drowsy or aged patients should never be left alone. When restraints are not used, the worker should always stay with the patient. In caring for the irrational patient, there is the possibility that he will injure himself in fighting against the restraining device. It should be remembered that the desire to be free is inherent, and often the use of a restraint is most disturbing to the patient.

Beds, stretchers, and operating tables must be equipped with brakes which should be locked when the patient is being moved. When injections are flowing into a patient's vein, a worker should always hold the container away from the patient's face and body as he is being moved onto a vehicle or as he is transported through a door. The flask may be accidentally broken, allowing the glass particles and fluid to injure him. Proper supports must be used to stabilize the patient on the table in the desired position (Chapter 4).

Before the patient is placed on the operating table, a member of the team should verify the site to be operated upon.

When intravenous fluids or drugs are to be administered, the worker should check the label on the container and the written order on the patient's chart. Proper emergency equipment should be available to meet the patient's particular problem.

A method of counting loose gauze sponges and pads, used in patients, should be clearly defined in writing (Chapter 4). Solutions used in patients should be kept at body temperature to prevent injury to tissues.

The operating room personnel should have a routine physical examination each year, including a chest x-ray. Personnel who assist in caring for patients during x-ray examinations or implantation of radium, or use of radioisotopes, must wear film badges and follow other safety rules to protect themselves and their patients from an overexposure of radiation.[74-79]

Nasal cultures should be taken of each worker when he first comes to the operating room and later at periodic intervals. A worker who has a cold or known respiratory infection should not enter the operating room units. To obtain a culture from a person's nose, take a sterile applicator, move it lightly over the membranes of the anterior nares, and then place the specimen in a tube of broth. By posting data from nasal and air cultures on the bulletin board in the nurses' and doctors' lounge, the personnel may be kept informed of cross-infection problems and the cleanliness of the air in the units and of the flooring. Some hospitals have found this to be a good way to emphasize the importance of applying medical asepsis.

Aesthetic Factors

A quiet environment is essential to patients and to the operating teams. The materials and colors used on walls and ceilings are described in Chapter 1.

THE USE OF MASKS

Considerations.–There is much controversy concerning the efficiency of face masks in controlling the spread of microorganisms from the respiratory tract. Although the respiratory tract has protective barriers to prevent the entrance of bacteria into the lungs, the healthy person still inhales bacteria as he breathes. When the workers expel many bacteria into the patient's wound, postoperative sepsis may occur.[19, 27-29, 53, 68-69]

The droplets of the respiratory tract, which consist of saliva, mucus, and many bacteria, are most often dispersed by coughing and sneezing. Because droplets are large particles, they frequently settle in quiet air; however, they may be inhaled by persons in the room or settle in the patient's open wound. Studies indicate that most large droplets which are expelled by a violent expiratory process evaporate before they reach the floor, since saliva consists of almost 99 per cent water.

Droplet nuclei are the solid residue of the droplets after drying. The small droplets become droplet nuclei before they can settle on an object. Because of their smallness and lightness, they float in the air for hours or pass through the mechanical "barriers" of the upper respiratory tract to enter the person's lungs. Findings of studies indicate that the nuclei remain in atmospheric suspension until they are breathed or die, and that it is the settling velocity which governs the retention of droplet nuclei in the atmosphere.[53]

When a person breathes quietly, the droplets are retained in the mask and are forced out when they become dry. The face mask filters an enormous number of bacteria from the air as the persons talks, laughs, and sneezes. A mask should not be worn longer than 30 minutes whenever possible. The longer time it is worn, the heavier the rate of contamination.[17, 29] Once the mask becomes damp, it is useless as a filter because the droplets can penetrate through it. There should always be a sufficient supply of masks on hand. A mask with a layer of impervious paper between the gauze layers does not retain bacteria since they are dispersed from the sides of the mask, due to the air currents.

Design of a Face Mask.–A face mask should be made of preshrunk double-ply cotton, and should be designed to fit the contours of the face so that it covers the nose and mouth. An effective mask consists of six layers of gauze, with 44 by 44 threads to the square inch, and 2 paired ties which will fit around the wearer's head and neck. Such a mask may filter 77 per cent of the pathogens from the air. A pliable metal strip is passed into the top casing of the mask so that it can be adjusted to fit the nose and help control fogging of the person's eyeglasses. When the mask is made of too many thick layers, the wearer must rebreathe the warm air he just expired, which is usually a most uncomfortable situation. Laundering reduces the space between the threads, thereby increasing the efficiency of the mask as a filter.

At present there is no efficient disposable mask on the market. The paper-film mask does not act as a filter, but only deflects the air.

Handling of Masks.–During the laundering process, masks should be rinsed in quaternary ammonium germicide, then pressed, sterilized with saturated

CLOTHING OF OPERATING ROOM PERSONNEL

To prevent the transmission of bacteria to other areas and to patients, the operating room personnel should not wear their street clothes or their ordinary hospital uniforms in the operating rooms. When they go to other areas in the hospital, such as the dining room, conference rooms, or the patients' units, they should wear their regular hospital uniform. In some situations, however, they may wear a clean coat or gown over their clean operating room clothing. When personnel have helped care for a patient with an infection, they should take a shower and put on clean, fresh operating room clothing.[28, 29, 43, 48, 84]

In surgery, men should wear sanitized short-sleeved cotton suits, and the women should wear short-sleeved cotton dresses. The uniform should provide for freedom of body motion and should fit the wearer properly. Men's trousers should not drag on the floor or require safety pins to hold them in place. Soiled uniforms should be discarded in a linen hamper designated for this purpose. Surgical uniforms should never be hung in a locker where street clothes are kept. To suppress dust and control the spread of air-borne organisms, uniforms may be treated with an oily emulsion and a quaternary ammonium germicide during the laundering process.[3, 17, 40]

Operating room personnel who will be working near inflammable anesthetic agents or liquids should not wear undergarments which are insulators. Such materials, including silk, wool, nylon, Dacron, Orlon, and rayon, can possess a high electric charge and retain it for long periods of time. The electrostatic leakage discharge in itself is harmless, but in the presence of electrified substances, a spark may be discharged from them.[42]

Nylon stockings may be worn since they fit the skin surfaces closely, and once the feet of the stockings are moistened with perspiration, they present little hazard. Nylon and other synthetic materials which contact the skin throughout their extent are also safe to wear. Women's undergarments made of synthetic materials present hazards if they are free enough to become charged through motion. The personnel should wear clothing that conforms to the rules set up by the National Fire Protection Association[33]

The surgical helmet, cap or turban, should be clean and should fit the person's head The person should apply it so that all his or her hair is covered. Soiled turbans must not be kept in lockers, but must be discarded in a sturdy cotton bag which is kept in a metal container with footpedal. The bag and its contents should be sent to the laundry at least once every eight-hour period.

If the floor is definitely conductive, the operating team must wear conductive-soled shoes or conductive guards over their shoes to remove static electricity from themselves and the equipment.[80, 81] The adjustable guard must rest against the heel, the back of the shoe, and on the sole, so that contact is established between it and the moist sock or stocking. Guards should withstand aging, even after repeated heat sterilization. Oily materials that inhibit conductivity should be removed, and shoes and guards should be washed with a germicide and sterilized to destroy bacteria.[84, 85] Before a person enters an operating room unit, the conductivity of his footgear should be measured by a conductometer. Results of such tests should be recorded on a form.

4. Housekeeping materials, such as a linen hamper, linen bag, a canvas bag, waterproof bags, suture jar, needle box, glove bag (if desired), and cleaning cloths.[13, 42]

Procedure.—Before a member of the operating team leaves the operating room unit, he removes his gown, gloves, mask, and cap, and places them in the proper receptacles. The inner surface of the gown is turned outward, the wet portion rolled inward, and the gown placed in the linen hamper (Chapter 3). The worker then washes his hands and arms, using a detergent solution. He should place his potentially contaminated uniform and soiled shoes in the designated receptacles in the dressing room.

To care for the soiled equipment, the tasks carried out by the gloved and gowned member of the nursing team include the following:

1. Collect all the contaminated linen and place it in the laundry bag.

2. Wet a cleaning cloth with germicide and wash off the blood spots and pus from the areas of the floor, walls, and furniture.

3. Place the soiled sponges and disposable materials in waterproof bags.

4. Place the pressure instrument-washer's tray on the instrument table, open and place the instruments in the tray, assemble the surgical needles in the needle box and place it on top of the instruments in the tray.

5. Disconnect the suction set and place the tubing and stopper on top of the instruments; empty the contents of the suction bottle into the hopper. The circulating nurse should turn the water faucets on and off. The gowned and gloved nurse should flush the suction bottle thoroughly with a detergent and place it in the sterilizer. The circulating nurse opens the door of the sterilizer and sterilizes the equipment.

6. The gloved and gowned worker empties the contents of the basins in a kick-bucket and places the basins in the high-speed pressure sterilizer. These are sterilized for 3 minutes at 270° F.

7. The soiled gloves are either sterilized in the instrument-washer sterilizer or placed in a waterproof bag to be discarded.

8. Catheters and instruments which can be damaged by exposure to heat sterilization should be immersed in a suitable germicide for the specified exposure period. Instruments, ampules, or suture needles contaminated with vegetative bacteria, including tubercle bacilli, and/or with some spores, may be disinfected by immersion for 8 hours in a germicide, such as an 8 per cent concentration of formaldehyde in 70 per cent alcohol.[5-8, 42]

9. The gowned and gloved worker discards her gown, mask, and cap in the laundry bag. She then closes the bag tightly and takes it to the door of the room, where another worker holds a special bag designated for this purpose. The outer bag is held open as the nurse places the bag containing the soiled linen into it.

10. The bag and its contents are discarded in the laundry chute; the flooring of the contaminated unit is scrubbed immediately with an electric vacuum containing a detergent solution and hot water.[13, 42]

steam, and stored in covered containers in a clean area near the scrub-up units. Workers who handle clean (sanitized) masks should wash their hands thoroughly before touching them.

Before the wearer puts on a mask, he should wash his hands so that he will not carry bacteria to the nasal passages, to be dispersed later into the air. A mask should never be carried in a pocket; and a soiled mask should not be taken to the dressing room. The mask can collect a tremendous quantity of bacteria because it is an effective filter. The longer it is worn, however, the higher the rate of contamination.

To remove a mask, the wearer should grasp only the ties and should immediately place the mask in a special container designated for this purpose. The metal strip may be removed and placed in a germicide solution; the strips should be rinsed under running tap water and heat sterilized. The wearer should wash his hands after removing and discarding his mask in the receptacle. When the worker removes the bag containing the soiled masks, he touches only the outer surface of the bag, deposits it in the laundry chute, lines the receptacle with a clean cotton bag, and then washes his hands. The receptacle should be thoroughly disinfected at least once every eight-hour period.

CARE OF EQUIPMENT AFTER A SEPTIC CASE

In surgery, when the patient's wound is contaminated or infected (septic), all pieces of equipment in the room must be disinfected or sterilized immediately after the patient leaves. A reliable, efficient procedure prevents pathogenic bacteria from spreading to other persons and other areas and protects the workers.

The bacteria must be destroyed before they have an opportunity to dry on the surface of objects or materials. The room is not quarantined and the walls are not washed unless their surfaces are known to be contaminated. Because it is not possible to destroy spores with nonvolatile disinfectants, the blood spots and pus on small areas of the walls and floors must be removed at once, using a germicide; and the floors must be scrubbed thoroughly with a detergent-disinfectant and hot water. The soiled laundry should be handled in such a way as to decrease the dangers of cross-infection. The members of the operating team should clean and sterilize the soiled equipment in the soiled unit, using the adjacent sterilizing facilities. When the unit's facilities are inadequate, the existing ones must be used efficiently. In caring for the patient with a suspected infection, the unnecessary pieces of equipment should be removed from the room before he arrives.

To carry out efficient care, the apparatuses needed include the following:

1. A high-speed pressure instrument sterilizer, a pressure instrument washer-sterilizer, and instrument trays.[4]

2. A good germicide for disinfection of catheters, lensed instruments, and flat surfaces of furniture.[5, 6]

3. A detergent, such as a 2 per cent solution of trisodium phosphate, for the washer-instrument sterilizer.[5]

21. Perkins, J. J.: Principles and Methods of Sterilization: in Institute on Operating Room Administration, Chicago, 1952, American Hospital Association, pp. 71-98.
22. Walter, C. W.: Method of Sterilization, Hosp. Topics 31:61, Feb. 1953.
23. Beckett, J. S., and Berman, P.: Sterilizing Surgical Supplies, Am. J. Nursing 52:1212, Oct., 1952.
24. Beck, C. F., Shay, D. E., and Purdum, W. A.: An Evaluation of Paper Used for Wrapping Articles to be Sterilized, Bull. Am. Soc. Hosp. Pharmacists 10:421, 1953.
25. Beck, C. F., and others: An Evaluation of Paper for Wrapping Articles, Bull. Am. Soc. Hosp. Pharmacists 12:511, 1955.
26. Leider, M., Furman, D., and Fisher, A. A.: Sensitivity to Rubber Materials, Arch. Dermat. & Syph. 65:387, 1952.
27. Brandstadt, W. G.: Air Pollution, U. S. Armed Forces M. J., 1:1195, Oct. 1950.
28. Howe, C. W.: Postoperative Wound Infections Due to Staphylococcus aureus, New England J. Med. 251:11, 1954.
29. Letourneau, C. V.: Nosocomial Infections, Hosp. Management 83:141, 1957.
30 Bond, R. G.: Sanitation and Safety Practices From Public Health Viewpoint, Hospitals 27:102, Aug., 1953.
31. Clarke, S. K. R., Dalgleish, P. G., and Gillespie, W. A.: Hospital Cross-Infections With Staphylococci Resistant to Several Antibiotics, Lancet 1:1132, 1952.
32. Dunklin, E. W., and Puck, T. T.: The Lethal Effect of Relative Humidity on Airborn Bacteria, J. Exper. Med. 87:87, 1948.
33. U. S. Department of Interior, U. S. Government Bureau of Mines Report of Investigation No. 44833, Static Electricity in Hospital Operating Room Suites: Direct and Related Hazards and Pertinent Remedies, Washington, D. C., January, 1952, U. S. Government Printing Office.
34. Marsh, F., and Rodway, H. E.: Bacteriology of Air and Dust in a Maternity Hospital, Lancet 1:125, 1954.
35. Joseph, J. M.: Disease Transmission by Inefficiently Sanitized Anesthetizing Apparatus, J A. M. A. 149:1196, 1952
36. Spencer, C. C.: Dusty Air as a Vehicle of Infection, Mod Sanitation 1:16, July, 1949.
37. Hart, P., Devine, J. W, and Martin, D. W.. Bactericidal and Fungicidal Effect of Ultraviolet Radiation Use of a Special Unit for Sterilizing the Air in the Operating Room, Arch. Surg. 38:806, 1939.
38 Miller, O. T., Schmidt, R F, and Phillips, G. B.: Applications of Germicidal Ultraviolet in Infectious Diseases in Laboratories, J Pub. Health 45:1420, 1955.
39 Robertson, O. H, and Lester, W, Jr.. The Lethal Effect of Triethylene Glycol Vapor on Dried Airborne Bacteria, Am. J. Hyg. 53:69, 1951.
40. Thomas, J C, and Van den Ende, M.: The Reduction of Dust-Borne Bacteria in the Air of Hospital Wards by Liquid Paraffin, Treatment of Bedclothes, Brit. M. J. 1:953, 1943.
41 Manual of Hospital Housekeeping, Chicago, 1952, American Hospital Association.
42 Manual of Hospital Housekeeping, Chicago, 1955, American Hospital Association
43 Anderson, G. W, and Arnstein, M. A: Communicable Disease Control, New York, 1953, The Macmillan Co
44 Armstrong, C: Atmospheric Conditions and Spread of Poliomyelitis, Am. J. Pub. Health 41:1231, 1951
45 Mottershead, E.: Four Phases of Preventive Maintenance, Mod Hosp. 84:120, 122, Feb, 1955.
46 Kjelland, R. C. Maintenance and Its Relationship to Safety, Hosp Topics 29:28, June, 1951.
47 Tuffley, Edna: Conference Problems, Hospitals 29:106, April, 1955.
48 Hovens, W P., and Paul, J R: Viral and Rickettsial Infections of Man, ed. 2, Philadelphia, 1954, J B Lippincott Co.
49 Hopkins, E. S, and Elder, F. B Practice of Sanitation, Baltimore, 1951, Williams & Wilkins Co.

11. The gloved nurse places her contaminated gloves in the waterproof bag with the other disposable materials, discards them in the incinerator chute, and then scrubs her hands and arms with a detergent.

If the facilities only include a boiling-water sterilizer, the instruments and utensils should be boiled for at least 30 minutes in a 2 per cent solution of trisodium phosphate. Soiled gloves and pieces of tubing should be placed in a waterproof bag and discarded. If only a dressing (autoclave) sterilizer is available, the instrument should be placed in a deep water-tight tray, covered with water, including a detergent (2 ounces of trisodium phosphate per gallon), and sterilized for 45 minutes at 250° F. The basins and suction bottle should be flushed with a detergent solution, rinsed thoroughly with tap water, and sterilized with saturated steam under pressure for 15 minutes at 250° F.

REFERENCES

1. Chandler, Velma L.: Sterilization of Supplies. I. Sterilization by Chemicals, Hosp. Topics, 33:85, Sept., 1955.
2. McCulloch, E.: Disinfection and Sterilization, ed 3, Philadelphia, 1954, Lea & Febiger.
3. Meleney, F. L.: The Bacteriological and Immunological Aspects of Surgery in Nelson's Loose-Leaf Surgery, Keenan, J. D. (ed), New York, 1955, Thomas Nelson & Sons.
4. Perkins, J.: Principles and Methods of Sterilization, Springfield, Ill., 1956, Charles C Thomas, Publisher.
5. Reddish, G. F.: Antiseptics, Disinfectants, Fungicides and Sterilization, Philadelphia, 1954, Lea & Febiger, chaps 1, 15
6. Spaulding, E. H.: The Bacteriologic Approach to Acute Surgical Infections and Disinfection Antisepsis, and Chemotherapy; in Babcock's Principles and Practice of Surgery, ed 2, Philadelphia, 1954, Lea & Febiger, chaps 5, 6.
7. Sanders, R. D., and Aikins, J. P.: Notes on the Characteristics, Composition and Care of Rubber Materials Used in Medical Goods, Hosp. Topics 33:12, March, 1955
8. Stedman, R. L., and others: Studies on the Efficiencies of Disinfectants for Use on Inanimate Objects II. Relative Activities on Porous Surfaces, Applied Microb. 2:322, 1954.
9. Carter, C. F., and Smith, A. L.: Microbiology and Pathology, ed. 6, St Louis, 1956, The C V. Mosby Co.
10. Maxcy, F. K.: Roseneau's Preventive Medicine and Hygiene, ed 7, New York, 1951, Appleton-Century Crofts, Inc
11. Wilson, G. S., and Miles, A. A.: Toply and Wilson's Principles of Bacteriology and Immunity, Baltimore, 1955, Williams & Wilkins Co., chaps. 6, 7, 13.
12. Taylor, J.: Recirculating Air in the Operating Room, Hospitals 29.98, May, 1955.
13. Warren, T.: Specialized Training and Specialized Plan of Housekeeping in Operating and Delivery Suites, Hospitals 29.104, April, 1955
14. American Medical Association: Report of the Council on Pharmacy and Chemistry; Use of the Terms "Sterile," "Sterilize," and "Sterilization," J. A. M. A. 107:38, 1936.
15. Spaulding, E. H.: Chemical Disinfection of Surgical Instruments; in Reddish, G. F.: Antiseptics, Disinfectants, Fungicides, and Sterilization, Philadelphia, 1954, Lea & Febiger, chap. 26.
16. Davis, B. D.: Principles of Sterilization, in Dubos, R. J.: Bacterial and Myocotic Infections of Man, ed. 2, Philadelphia, 1952, J. B. Lippincott Co
17. Walter, C. W.: Aseptic Treatment of Wounds, New York, 1948, The Macmillan Co
18. Walter, C.: Question Box, Hosp Topics, 1954, 1955
19. Walter, C. W.: Aseptic Technics in the Postdoctorate Program, Hosp Topics, 34:95, April, 1956
20. Gershenfeld, L.: Recent Developments in Iodine as a Sanitizing Agent, Mod Sanitation 7:26, March, 1955.

80. Greene, B. A.: Place of Leather-Soled Shoes in the Prevention of Anesthesia Explosions, Anesthesiology 13:203, March, 1952.
81. Hudenberg, E. R.: Safe Practices for Hospital Operating Rooms, Hospitals 30:35, Dec., 1956.
82. Fleming, Sister S. J.: Safety for Hospital Patients, Am. J. Nursing 53:165, April, 1953.
83. Low-Beer, B. V.: Organizing and Controlling the Use and Safe Handling of Isotopes, Hospitals 29:51, Dec., 1955.
84. Baker, A: How to Keep Conductive Floors Conductive, Mod. Hosp. 82:126, June, 1954.
85. Davenport, S. J, and Margis, G. G.: Air Pollution and Bibliography, Bull. 537, U. S. Bureau of Mines, Washington, D. C., 1954, U. S. Government Printing Office, p. 488.
86. Lurie, M. B, and Abramson, S.: Do Masks Protect? Am. J. Nursing 49:100, Feb., 1949.
87. Lurie, M. B., and Abramson, S: The Effect of Gauze Masks in Protection of Rabbits Against the Inhalation of Droplet Nuclei of Tubercle Bacilli, Am. Rev. Tuberc. 59:1, Jan, 1949.
88. *Rooks, Roland, Cralley, L. J., and Barnes, M. E.: Hospital Masks; Their Bacterial Filtering* Efficiency and Resistance to Air Flow; Comparative Study, Pub. Health Rep. 56:1411, 1941.
89. McNett, E. H.: The Face Mask in Tuberculosis, Am. J. Nursing 49:32, Jan, 1949.

50 National Safety Council and American Hospital Association. Better Maintenance Hospital Safety—Manual and Check List, Chicago, 1955, American Hospital Association.
51. Beach, R: Electrostatic Explosion Control in Hospital Operating Rooms, Hosp Progress 37:65, March, 1956.
52 Thomas, G. J.: Fire and Explosion Hazards With Flammable Anesthetic Agents and Their Control, J. Kentucky, M A 54:27, Jan., 1956
53. Duguid, J. P.: The Size and the Duration in Air: Carriage of Respiratory Droplets or Droplet Nuclei, J Hyg 44:471, 1946.
54 Duguid, J. P., and Wallace, A. T.: Air Infection by Dust Liberated From Clothing, Lancet 2.845, 1948.
55 Elliker, P. R., and others. Cleaning and Bactericidal Values of Detergent-Sanitizers, J. Milk & Food Technology 13:215, 1950
56 Church, B D., and Loosli, C. G: The Role of the Laundry in the Recontamination of Washed Bedding, J. Infect. Dis. 93.65, 1953
57 Johnson, B L: Buying Safety Against Operating Room Explosion Hazards, Hospitals 24:87, Dec, 1950.
58 Lincke, E. J: How to Keep Conductive Floors Conductive, Mod. Hosp. 86:128, March, 1956.
59 Henderson, Virginia: in Harmer, Bertha L. (ed): Textbook of the Principles and Practice of Nursing, ed. 5, New York, 1955, The Macmillan Co, chap. 7.
60 Eddy, G W.: The Treatment of Head Lice With MYL and DDT Louse Powder and NBIN Emulsion, Am. J. Hyg 46:29, Jan, 1948.
61 Errera, D. W., and Walter, C. W.: The Care and Sterilization of Catheters, Drains and Tubes, Hosp Topics 34:93, Aug, 1956.
62 Barrett, R. H: Explosion Hazards in the Operating Room, Hosp. Topics 33:86, Oct, 1955
63 Beach, R: Safety From Anesthesia Explosions in Hospital Operating Rooms, Hosp. Topics 31:82, Oct, 1953.
64. Dolezal, C T.: Safety Measures in Hospital. I, Hospitals 28.60, June, 1950.
65 Gill, M J Straps Safeguard Patients, Hosp Management 71:106, Feb, 1951.
66 Gilroy, J: When Planning to Modernize Your Operating Room Suite, Give First Consideration to Safety, Hosp. Management 76 47, Nov, 1953.
67 Goldstein, C, and Werley, Harriet: Atomic Disaster. Medical and Nursing Care, Am. J. Nursing 56:1576, Dec, 1956.
68 Griffin, N L: Preventing Fire and Explosions in the Operating Room, Am. J. Nursing 53:809, July, 1953
69. Jacobs, A E Safety Preferred to Sorrow—Remodeling the Operating Room to Assure Safety, Hospitals 24:42, Feb, 1950
70 Kuehne, R P Good Equipment Means Better Nursing, Mod. Hosp. 86:74, Jan, 1956
71. Amicarella, H: At Evanston Hospital, Employees Plan for Safety, Mod. Hosp 82:72, June, 1954
72 Adams, R E, and Riley, L R: Fire Equipment Doesn't Frighten Them Now, Mod. Hosp 86 80, May, 1956
73. Barton, Jane What Would You Do in Case of Operating Room Explosion? Mod. Hosp. 86:51, Feb, 1956.
74. National Safety Council The Woman on the Job Her Health and Safety, Chicago, 1954 p 88.
75. Emmons, A H: Evaluation of Radiation Exposures, Am J Nursing 55:1505, Dec., 1955.
76. Morgan, G. W: Facilities and Equipment for Isotopes Program, Hospitals 29:103, March, 1955
77. Shane, S. S: Protection From Scattered Radiation During Fluoroscopy, Canad. M. A. J. 71:282, 1954.
78. Terrenzio, J. V.: The Operating Room Nurse and the Law I, Hospitals 30:34, 1956.
79. U. S. Department of Commerce, National Bureau of Standards: Maximum Permissible Amounts of Radioisotopes in the Human Body, Handbook No. 52, Washington, D C, 1953, U S. Government Printing Office

tures taken from unscrubbed surfaces show many types of bacteria, frequently including the staphylococci and streptococci.

Price's studies on bacterial counts of the skin show that the number of bacteria removed from the skin by washing with a sterile brush and distilled water becomes less and less, and that normal bacterial flora take about ten days to re-establish themselves when the skin is freed of all bacteria possible to remove by one scrubbing.[10] Washing the skin thoroughly with a soap or detergent removes the film of grease, oil, and transient flora on the surface and the resident flora just beneath the surface.

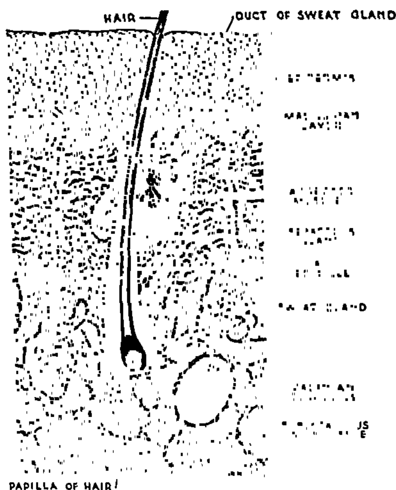


Fig 11 —Vertical section of the skin (schematic). (After Cunningham, from Zoethout, W D, and Tuttle, W W. Textbook of Physiology, St Louis, 1955, The C V. Mosby Co)

Frequent washing is necessary to combat the effects produced by the activity of the sweat glands Their activity is also increased due to external heat, emotional stress, and certain drugs The resident flora of the skin are forced to the surface in the perspiration. Even though this is one way the skin disinfects itself, the bacteria become a source of infection in surgery. Cultures taken from the cleansed skin which has been enveloped in a sterile glove show growth of virulent organisms, and cultures taken from the skin of patients who are in a humid or warm atmosphere and from the surfaces of the operator's hands which are

CHAPTER 3

SKIN DISINFECTION AND GOWNING AND GLOVING PROCEDURES

In preparation for surgery, the skin area is cleaned, using a detergent or soap, and then painted with a germicide to help prevent the transference of disease-producing organisms from person to person and from skin surfaces to the open wound.

The methods for the disinfection of the patient's proposed operative site and for the surgical scrub by members of the operating teams may vary in different hospitals. The method used, however, aims to remove as many disease organisms as possible, control the normal epidermal flora, and recondition the skin area.[1-5]

The procedure to be used depends upon the following factors: (1) the condition of the involved area, (2) the number and kinds of contaminants present, (3) the characteristics of the skin to be disinfected, (4) the patient's physical condition, and (5) the type and location of the injury and lesion. The person who prepares the patient's skin area or who does a surgical scrub should be carefully trained in the technique of disinfecting skin areas so that bacteria are removed and not forced down into the skin layers.

SCIENTIFIC FACTORS OF SKIN CLEANSING AND DISINFECTION

Proper skin disinfection is based on knowledge of the physiology and bacteriology of the skin[4,7-10] This complicated structure comprises two distinct layers (1) the superficial layer, which is called the epidermis, and (2) the deeper layer, which is called the dermis (Fig. 11).

Price's[9,10] studies show that bacteria grow downward into the newly formed cells of the dermis at about the same rate as the mature cells and dead ducts of the glands are pushed upward onto the skin surfaces.[9] Price refers to the epidermal flora as the "transient flora." They represent the contaminating bacteria and soil picked up by contact with various objects and the detritus of the normal skin. The bacteria which grow and multiply in the deeper layers of the dermis, in the depths of the skin glands, and under the fingernails are called "saprophytic bacteria," or the "resident flora" of the skin.

Because of the mechanism of the skin and the skin glands, it is important to remove the contaminates as quickly as possible from the broken or unbroken skin surfaces. Cultures taken from the skin following a ten-minute scrub show growth of some disease organisms normally present in the dermis. However, cul-

tissues if used in an open wound. If an insoluble soap is used with a brush, it must be freed of all alkali earth film, since it may cause dermatitis.[2,14,15]

Recent studies indicate that skin detergents which contain hexachlorophene (G-11) have the power to suppress resident flora if the detergent is used routinely. Hexachlorophene is a chlorinated phenyl compound which is insoluble in water but soluble in alcohol. It also retains its antibacterial power in the presence of soap.[13,22,23] Many authorities advocate its use; however, the greatest advantage of a synthetic detergent containing G-11 is that of suppressing bacteria. The agent should be used each day by persons who scrub.[14] Preoperatively, the patient's proposed skin area should be washed with the detergent once or twice a day for several consecutive days prior to surgery.

After a surgical scrub, a germicide, such as a 1 to 1,000 solution of aqueous Zephiran chloride (alkyldimethylbenzylammonium chloride), may be applied to the skin. Zephiran chloride is compatible with pHisoHex, but is incompatible with soap.[10,23,26] A stainless tincture of aqueous Zephiran may be used as an arm soak solution in surgery.[14,21]

Alcohol is a good antiseptic. Studies indicate that a 50 to 95 per cent isopropyl alcohol has more germicidal action, fat solvent action, lower surface tension, and costs less than ethyl alcohol of the same concentration.[10,18] Since alcohol is a powerful protein precipitant, it is not used in an open wound or applied to mucous membrane. In an emergency, unbroken skin may be disinfected with alternate sponges saturated with aqueous Zephiran and isopropyl alcohol. Alcohol should not be applied to the skin when a cautery is to be used, since the sheet saturated with alcohol gives off alcohol vapor which can be ignited by the electric charges coming from the cautery in use.

The proposed unbroken skin area may be painted with a U.S.P. tincture of 1 or 2 per cent iodine dissolved in 70 per cent alcohol. This solution is an effective skin antiseptic since the alcohol provides the "wetting" power for the iodine which is highly bactericidal and which possesses a low tissue toxicity.[28] To disinfect the skin, the iodine solution is lightly applied, allowed to dry, and the excess amount removed, leaving a uniform stain on the skin. Before the wound dressings are applied, the excessive moisture should be removed from the wound. Iodine should not be used if a mercurial antiseptic has been applied previously.

Soiled skin wounds of compounded tissue may be irrigated thoroughly, using a diluted solution of calcium hypochlorite, followed by thorough flushing with liters of sterile normal saline.[15,16] In cleansing traumatic injuries, the skin may be washed with a detergent, the wound irrigated with liters of normal saline, and the skin painted with a germicide, such as Zephiran.

Ether is also another potential explosion hazard, and has little degerming action. It is a good fat solvent, but is irritating to the tissues.

INITIAL CLEANSING OF PROPOSED OPERATIVE AREA

The operating room nurse or the nurse who is caring for the patient may prepare the proposed operative site. In some cases the washing is done in the operating room rather than in the patient's unit.[1-3,29,33]

enveloped in sterile rubber gloves also show growth of organisms normally living and growing in the depths of the skin glands.[10-15]

The acidity of perspiration acts as a protective barrier against disease organisms on some parts of the body, but is only powerful against organisms for the pH ranges from 3 to 5. In the axillary and pubic regions and in the interdigital spaces, perspiration is less resistant to bacteria, since it is neutral or even alkaline.[12] In preparation for surgery, such areas must be disinfected thoroughly to remove the transient organisms and suppress the remaining resident flora. Bacteria can also grow and multiply in the detritus within the folds, ridges, and crevices of the skin. In washing, it is important to soften the detritus in order to remove the organisms.

The thickness of the skin also influences the amount of friction to be applied. If a thin surface is scrubbed vigorously, all desquamating epithelium may be removed, leaving a bleeding or weeping dermis. This condition is most painful and also increases the danger of infection.[10,15]

Friction is not only helpful in removing bacteria and detritus, but also in producing heat which dilates the blood vessels.[4] This provides for better circulation which in turn helps to recondition the skin.[2] During washing, the skin should not be rubbed or massaged since such action may force bacteria into the deeper dermal layer. The person who uses a brush incorrectly may force the transient contaminants into the skin, so that he becomes a carrier of virulent organisms.

The cleansed skin surface should be blotted dry, not rubbed, using sterile gauze or compressed cotton sponges or a towel, since the adhesion between the article and moisture on the skin is greater than the adhesion between the droplets.

AGENTS FOR SKIN DISINFECTION

The many thousands of bacteria which are present on the normal healthy skin can be removed more effectively by proper washing, using friction rather than application of an antiseptic agent.[10,14,16]

The detergent-germicide or soap to be used on the skin should meet several requirements. According to Guild's[17] studies on cutaneous detergents, an effective agent should emulsify and peptize the waste products and oils that have been adsorbed by soil, so that the detritus can be rinsed off the skin, using water.[17,18] The agent should hydrolyze in the presence of water and should give a pH which corresponds to that of the average normal skin. The agent should not disturb the normal functioning of the skin, should produce a good lather, be odorless, and easy and comfortable to use, and should conserve costs.[19-27]

Price's studies of the bacterial counts of the skin, before and after surgical scrubs, where different types of soaps and detergents were used, indicate that most of them produce about the same results.[10]

Neutral and superfatted soaps may be used since they contain fatty acids, and when mixed with water, hydrolyze to give an alkaline reaction. Although soap is a good cleansing agent for unbroken surfaces, it may be irritating to the

tissues if used in an open wound. If an insoluble soap is used with a brush, it must be freed of all alkali earth film, since it may cause dermatitis.[2,11,17]

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Setup.—A clean setup should be used for each patient to prevent the transfer of bacteria. After use, all pieces of equipment should be washed and sterilized, the disposable items discarded, and the soiled linen placed in the linen hamper.

Routine items include the following:

1 Wash basin
1 Small basin
1 Sterile straight razor (or razor and sharp new blades)
1 Stainless steel file
3 Cotton applicators
1 Nylon-bristle brush
6-10 Compressed paper sponges, commercially made
2 Sterile towels
6 Gauze sponges
Detergent or soap solution
1 Plastic protective sheeting
Tap water in a flask
Patient's gown and bed linen
Supports to stabilize patient
Linen hamper
1 Pair sterile gloves to clean unbroken grossly contaminated areas
1 Hair clippers, or a vaginal irrigation setup, or other special items, as needed

Procedure.—To wash the skin area effectively, the worker applies the principles of nursing and asepsis.

1. When the patient is awake, the worker first tries to gain his confidence and cooperation by telling him why the procedure must be done and how it is to be done. She tries to answer his questions and gives him the reassurance he needs at this time.

2. She examines the area to be washed for signs of irritation or pimples, reports any abnormal condition to the physician, and gets his permission to discontinue the procedure if necessary. She also asks the patient if he has had any skin reaction to the use of soaps or disinfectants.

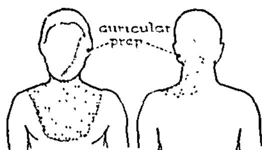
3. She considers his comfort, safety, and privacy as she places him in the bed or chair, or on the stretcher in the desired position. She makes sure good body alignment is maintained and that the position will permit her to work quickly and easily without causing undue strain on the patient or to herself. She then arranges the equipment near the patient and adjusts the lamp.

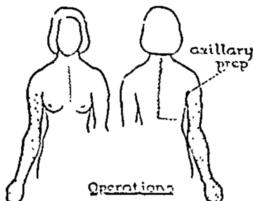
4. The area to be cleansed will depend upon the location of the proposed operative site, and the steps of the procedure will depend upon the condition of the patient (Fig. 12).

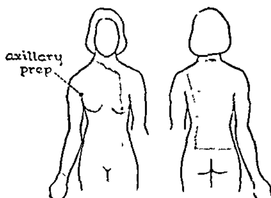
The basic steps of skin cleansing include the following: Saturate the area with a suitable detergent (pHisoHex) or a soap solution. First wash the center area of the proposed flat surface, gradually working out to the periphery. Use eigth straight strokes or a circular motion. Keep the wrist relaxed so that the arm will not be strained. If necessary, remove gross dirt from the nails, using a metal nail file, and trim nails. Wash the area for one to two minutes and develop a good lather.

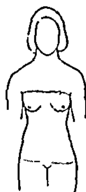
Shave off the lather with a sterile razor, rinse the area, and blot it dry. Discard soiled sponges in a small basin. If an extremity is to be washed, use the wash basin, allowing the water to flow from above downward.

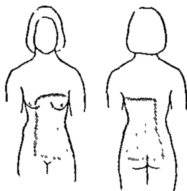
Scrub the area a second time for three minutes, using a brush or sponges. Rinse the surfaces and blot them dry with a sterile towel or sterile sponges. To cleanse the folds and crevices of the skin, place a sponge saturated with detergent or soap over the area to loosen the detritus; then first scrub the flat surfaces. To











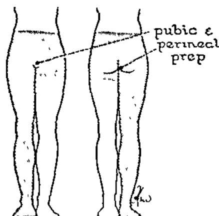


Fig 12—Diagram of areas of skin preparation (From Moseley, H F Textbook on Surgery, St. Louis, 1955, The C V Mosby Co)

cleanse skin surfaces over superficial lesions or sensitive tissues, wash the skin gently, applying light friction. Preparation of the scalp for a brain operation is described in Chapter 6 and for traumatic wounds, in Chapter 17.

After completion of the procedure, make the patient comfortable, make sure the equipment is washed and sterilized, and scrub own hands and forearms.

FINAL SKIN DISINFECTION OF THE OPERATIVE SITE

The patient's proposed operative site is disinfected after the patient has been placed on the operating table or in a chair in the desired position and just before the sterile sheets and towels are placed over him.

Setup.—The sterile utensils and supplies may be arranged on a small, sterile table for the operator to use. If the items are kept on the instrument table, the "scrubbed" nurse will hand the items to the operator.

The items include the following:

2 or 3 Towels
1 Hand towel
1 Pair of rubber gloves for septic cases
3 Stainless steel medication cups for solution
Soap or suitable detergent
Sterile distilled water or sterile normal saline
Germicide
Gauze sponges of a suitable size
3-4 Sponge-holding forceps

Procedure.—In preparing the individual patient the operating team follow basic aseptic techniques.

The circulating nurse seals off an open stoma if present, using adhesive or cellophane strips.

The operator who is to carry out the procedure scrubs his hands and forearms and may or may not wear sterile gloves.[3] Usually sterile gloves are not worn if an effective detergent is used and the unbroken skin is not grossly contaminated.[1,31]

To protect his hands and forearms from the unsterile linen and unclean skin surfaces, the operator opens a towel and places one side of the towel transversely on the lower margin of the prepared skin area, then places a second towel across the upper margin of the prepared area (Fig. 13). In the preparation of an extremity, towels are placed on the table beneath the affected area, and an assistant supports the extremity as the operator washes the skin surfaces (Chapter 17).

When the gloved and gowned nurse hands the sterile towels and gauze sponges to the operator, she does not allow her gloved hands or gown to come in contact with unsterile objects or with the operator's hands. Any object which comes in contact with the skin is unsterile since the skin is not sterile. In some cases the free sponges are dropped on the sterile towel over the patient.

To disinfect a flat surface, the operator applies light friction, using a circular motion and gauze sponges saturated with a detergent or soap (Fig. 12). He starts at the center of the proposed site and proceeds to the periphery. (Fig. 13) Several wet sponges are needed, since a soiled sponge is never brought back onto a washed surface. To prepare an extremity, the operator starts at the most elevated region and proceeds downward.

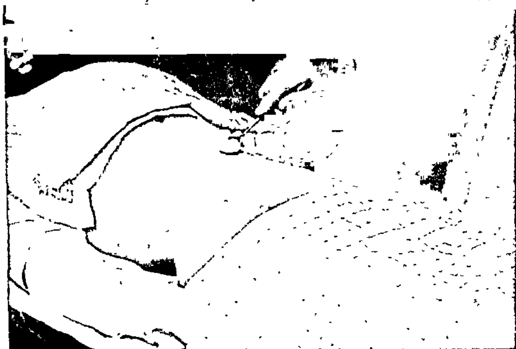


Fig. 13 —Preparation of the abdomen. The assistant wears sterile rubber gloves A sterile towel is placed at each extremity of the area to be cleansed. (From Maes, V, and Ilgenfritz, H. C.: Aseptic Surgical Technic; in Lewis' Practice of Surgery, vol. I, Hagerstown, Md., 1955, H. F. Prior Co, Inc)



Fig 14.—Preparation of the abdomen—cont'd The operative skin area may be cleansed with a detergent or alcohol Antiseptic solution is dropped from the gauze sponge onto the abdomen (From Maes, V., and Ilgenfritz, H C Aseptic Surgical Technic, in Lewis' Practice of Surgery, vol. I, Hagerstown, Md, 1955, H F Prior Co, Inc)

Suds are wiped off, using dry sterile gauze sponges. The area is rinsed, using sponges saturated with sterile water or sterile normal saline, and the area blotted dry. A germicide is applied, using sponges secured to sponge holders (Figs. 14 and 15).[3,16,17,28]

After disinfecting the operative skin area the operator scrubs his own hands and forearms for one minute, using a detergent-germicide, then rinses his hands and forearms thoroughly under running water and soaks them in a germicidal solution for one minute, if desired.

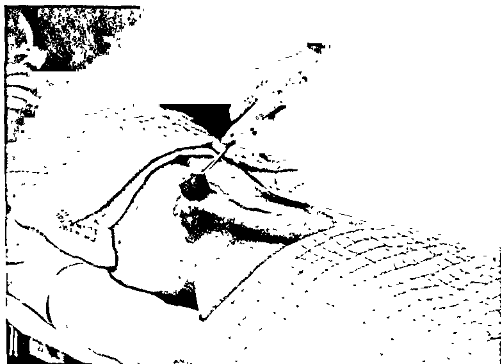


Fig 15—Preparation of the abdomen—cont'd Antiseptic solution is applied by circular strokes, beginning at the proposed operative site and continuing outward. (From Maes, V., and Ilgenfritz, H C Aseptic Surgical Technic, in Lewis' Practice of Surgery, vol. I, Hagerstown, Md, 1955, H F Prior Co, Inc)

SURGICAL SCRUB

The person wears the regulation operating attire which has been described in Chapter 2. The facilities of a scrub room are described in Chapter 1.

Setup and Preparation.—The items include two nylon-bristle brushes or several gauze sponges, a stainless steel nail file, detergent or soap, and a germicide for arm dip.

After use, the brushes and nail files are washed thoroughly, placed in a metal container, and sterilized for 15 minutes in saturated steam at 250° F., or sterilized in the high-speed steam sterilizer for 3 minutes at 270° F. During the sterilization of the brushes and nail files, each cover should rest against one side of the container. The container should be covered when the setup is not being used.

Procedure.—The operating room procedure book should include the general rules for scrubbing. The anatomic counted scrub, with a brush, or the time-measured scrub, using a brush or gauze sponges, may be carried out. Walter recommends the anatomic count scrub, using a brush.[3,14] Gauze sponges, rather than brushes, are being used more frequently today, as they are less irritating to the skin. When the surfaces are grossly contaminated with soil and bacteria, a brush may be needed; otherwise, scrubbing the hands and forearms each day, using gauze sponges saturated with a detergent or soap, is sufficient.

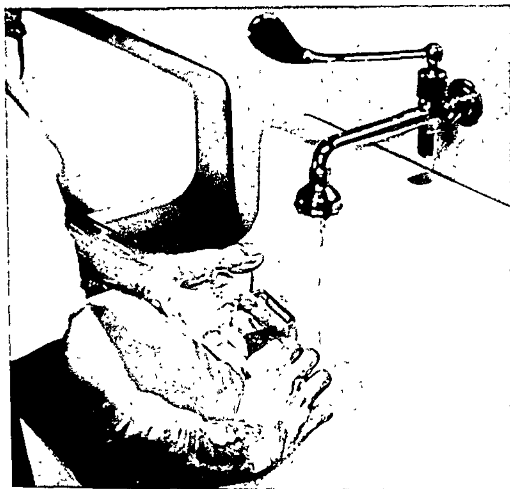


Fig 16.—Preparation of hands, using soap or a detergent. (From Maes, V., and Ilgenfritz, H. C.: Aseptic Surgical Technic; in Lewis' Practice of Surgery, vol. I, Hagerstown, Md., 1955, H. F. Prior Co., Inc.)

Rules for surgical scrubbing should be defined to meet the different situations. In most hospitals the operating room personnel who are to wear sterile gowns and gloves do a complete scrub prior to caring for the first patient assigned to their unit. If this patient has an infection, or if the worker's gloves become torn or his hands contaminated, a complete scrub is necessary before caring for the next patient. In the absence of gross contamination, a short scrub is sufficient.

The steps of the scrubbing procedure include the following:

1. Turn on the faucets and bring the water to the suitable temperature. If the hands are grossly contaminated, place a paper towel over the hand levers; then discard the towel in the waste receptacle.

2. Wet the hands and apply a few drops of detergent or soap, then mix with water; make a good lather and scrub the hands and forearms to 3 inches above elbows (for 30 to 60 seconds). The amount of time will depend upon the type of detergent used and the degree of contamination.

3. Take a sterile brush or gauze sponge and saturate it with 6 to 8 drops of a detergent or soap, scrub the nails and the hands for one minute, using soap, or one-half minute, using a detergent such as pHisoHex (Fig. 16).

4. Place the brush or gauze sponge in one hand or hold the bar of soap on the back of the brush, and then take a metal nail file and scrape the subungual spaces. Discard the file in the sink. The nails should have been trimmed previously to 1 mm. in length.

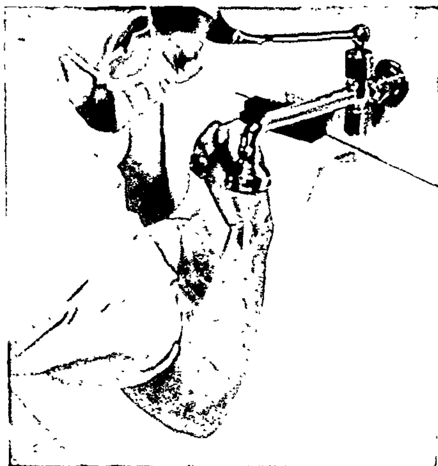


Fig 17—Preparation of hands—cont'd To prevent contamination, hands are held upward while soap or detergent is washed off (From Maes, V., and Ilgenfritz, H C.: Aseptic Surgical Technic; in Lewis' Practice of Surgery, vol I, Hagerstown, Md, 1955, H F. Prior Co, Inc.)

5. Scrub the nails and each hand for one minute, rinsing the hands and brush. Discard the brush or gauze sponge in the sink.

6. Apply 2 to 4 ml. of detergent (pHisoHex) or liquid soap to the palm of each hand and add water to make suds; then take a second brush or gauze sponge and wash or scrub each forearm for 2 minutes. Start the scrub above the elbows, working downward over the hands and covering all surfaces with plenty

of suds. To conserve energy during the scrub, relax the wrists and make straight short strokes or small circular motions.

7. Rinse the suds from the hands and forearms, holding the hands downward to allow the water to run off the fingers (Fig. 17).

8. If arm levers are used, turn them off with the brush or upper portion of the arm.

9. Keep the hands higher than the flexed elbows to allow the water to drip off them and to prevent the water from running on to the forearms.

10. Soak the hands and forearms for one minute in an antiseptic.

11. Keeping the hands up and in front of the body, with the elbows slightly flexed, prepare to put on the sterile gown or to dry the hands.

GOWNING AND GLOVING PROCEDURES

Before the scrubbed worker can touch sterile equipment or the sterile field, he must put on a sterile gown and sterile rubber gloves to prevent bacteria on his hands and uniform from being transferred to the patient's wound during surgery. The sterile gown and gloves also protect the worker's hands and uniform from bacteria present in the patient or in the atmosphere.

Design and Packaging of Gown and Gloves

The gown should be made of a good quality of cotton which provides for complete penetration of steam during the sterilization process. The shape and size of the gown should fit the wearer but not hamper him. To provide for extra protection, the gown's front (from the waist upward) may be made of two thicknesses of material. Each sleeve should be finished with a tight-fitting wristlet, which prevents the inner side of the sleeve from slipping down onto the outer side of the sterile glove. Cotton tapes or grip fasteners are attached to the back of the gown to hold it closed.

A double-flap gown may be used to provide for a sterile back. One side of the flap is sewn to the uppermost side of the gown and tapes are sewn to the opposite side of the flap and gown. In surgery, these tapes are tied together to hold the flap in place (Fig. 28).

Because the outer side of the gown's front and sleeves will come within the sterile field during surgery, the gown must be folded so that the scrubbed worker can put it on without touching the outer side with his bare hands. To prepare a gown for sterilization, turn the gown so that the outer side of the front piece is uppermost, straighten the sleeves, fold the edges of each back to the center of the front piece, then fold the gown in thirds from bottom to top so that the neck portion is uppermost. Place a folded towel on top of the gown. One or four gowns, each with a towel, are packaged in a double-thickness muslin wrapper and sterilized for 30 minutes in saturated steam at 250° F. (Fig. 4).

In the preparation of gloves, each glove's cuff is turned back so that the scrubbed worker can grasp the glove's inner side with his bare hands. Because the cleansed skin is not sterile, it must not come in contact with the outer side





Fig 18.—To dry hand and forearms, the scrubbed worker places free hand on one end of the towel which rests over the other hand, and then dries the free hand

Fig 19.—To dry forearm with a clean "sterile" portion of the towel, the scrubbed worker shifts the towel over the hand The towel must not touch the unsterile uniform



Fig. 20—To dry the forearm, the scrubbed worker leans slightly forward, keeps the arms away from the body and flexes the elbow of the arm being dried To dry the other forearm, the scrubbed worker grasps the free clean end of the towel with the dried hand The towel is never brought back onto a dry, clean area.

of the glove, which will later come in contact with the sterile field. Each pair of gloves is placed in a billfold-type muslin cover in such a way to provide for complete sterilization (Figs. 8 and 9). An envelope of Bisorb powder is placed in the pocket of the cover.[34,36] Each envelope is wrapped in a muslin cover, and then sterilized for 15 minutes in saturated steam at 250° F. (Chapter 2). In many operating rooms the sterile envelope containing the gloves is placed under the sterile gown on the sterile table. The neck of the gown should be uppermost and face toward the back of the sterile table. If necessary, the scrubbed worker may take the gown from its muslin cover after the circulating nurse has turned back its flaps.

Drying the Scrubbed Hands and Forearms

The scrubbed worker may dry the surfaces with a sterile towel before he puts on the sterile gown, or he may dry his hands just before he puts on the sterile gloves.[3,16,27]

To dry the hands and forearms, grasp the folded towel with the fingers of both hands, step back from the table, extend the arms and open the towel. Place one end over one hand and blot dry the free hand and then the forearm, making sure that the towel does not touch an unsterile object. The used (unsterile) portion of the towel is never brought back onto a dried area. Grasp the remaining sterile portion of the towel with the free hand and proceed to dry the opposite wrist and forearm, using a rotation movement. Discard the towel in the receptacle designated for this purpose. (Figs. 18 to 20.)

Putting on the Sterile Gown

Considerations.—The outer side of the sterile gown must not touch an unsterile object or the worker's scrubbed hands, except that portion of the wristlet which will be covered by the cuffs of the sterile rubber gloves. The scrubbed worker touches only the inner side of the gown with his bare hands. The circulating nurse touches the gown's inner side at its shoulder and arm seams, and the outerside at the center back, the ends of the tapes, and the buttons or fasteners. In handling the gown, the scrubbed worker uses certain body movements which provide for a safe performance.

Procedure.—The major steps to be carried out by the scrubbed worker and the circulating nurse are described in Figs. 21 to 28.

Powdering the Scrubbed Hands

Considerations.—A thin film of Bisorb powder is applied evenly and gently over the surfaces of the scrubbed hands so that the sterile gloves can be slipped on with ease and safety. Although Bisorb powder can be absorbed by the tissues, the excess powder which has touched the skin and escaped into the atmosphere can become a source of infection[2,34,36]

Procedure.—To powder the hands the steps include the following: Grasp the protruding end of the envelope containing the powder. Stand near the waste receptacle. Open the envelope and pour the powder carefully onto the palms.





Fig 18—To dry hand and forearms, the scrubbed worker places free hand on one end of the towel which rests over the other hand, and then dries the free hand.

Fig 19.—To dry forearm with a clean "sterile" portion of the towel, the scrubbed worker shifts the towel over the hand The towel must not touch the unsterile uniform.



Fig 20—To dry the forearm, the scrubbed worker leans slightly forward, keeps the arms away from the body and flexes the elbow of the arm being dried. To dry the other forearm, the scrubbed worker grasps the free clean end of the towel with the dried hand The towel is never brought back onto a dry, clean area.



Fig. 25.



Fig. 26.

Fig 25.—The circulating nurse places each hand on the inner side of the gown at each shoulder seam and pulls the gown over the wearer's shoulders.

Fig 26.—When one inner tape is secured to the inner side of the gown and a second tape is attached to the edge of the opposite back, the circulating nurse ties them together before closing the gown



Fig 27.—To close the gown, the circulating nurse grasps the ends of the tapes and ties them together, or she secures the buttons or fasteners in place. The scrubbed worker should keep the arms in front with the elbows flexed



Fig 21

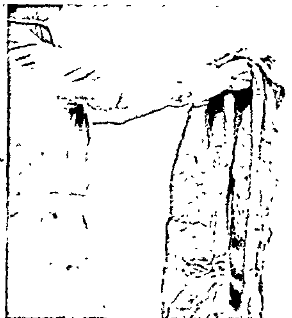


Fig 22.

Fig 21-28 —Putting on a sterile gown, eight steps

Fig 21.—The scrubbed worker grasps the folded gown, steps back from the table, and extends the arms at a level with the upper chest to prevent the gown from touching an unsterile object.

Fig 22.—The scrubbed worker, keeping the arms extended and elbows slightly flexed, grasps the ends of the neck band with both hands and shakes the gown slightly to open it.



Fig 23.



Fig 24

Fig 23 —The scrubbed worker introduces each hand into an armhole, keeping the arms extended and making sure the sleeves do not touch an unsterile object

Fig 24 —To introduce the forearms into the upper portion of the sleeves, the worker flexes the elbows and adducts the arms. To bring the hands through the sleeves, she abducts the arms and waits for assistance, keeping the arms upward

Discard the envelope in the waste receptacle. Apply the powder gently over the surfaces of the hands.

Putting on Sterile Gloves

Considerations.—The everted cuff of each glove permits the worker to touch the glove's inner side with his ungloved fingers and to touch the glove's outer side with his gloved fingers. The gowned worker should keep his hands in front at a level with the waist, flex his elbows, exert a light, even pull on the glove to bring it over the hands, and, using a rotation movement, bring the cuff over the wristlet. When it is necessary to hold the pleat made at the bottom of the sleeve, the gloved thumb of the opposite hand should not touch the bottom of the wristlet since it has touched the skin.

Procedure.—The major steps to be carried out are described in Figs. 29 to 36.

Assisting a Scrubbed Worker in Gowning and Gloving

The gowned and gloved assistant should grasp the sterile gown near the neck band, unfold the gown so that its inner side is turned toward the scrubbed worker, and then hold the opened gown, turning her gloved hands so that they are protected by a portion of the outer side of the gown. She holds the gown until the worker has inserted his hands and forearms into the sleeves. The scrubbed worker abducts his arms as the circulating nurse pulls the gown over his shoulders. The circulating nurse ties or buttons the gown at the back, as described previously.

To assist the gowned worker in putting on sterile gloves, the gowned and gloved assistant opens the envelope of powder, pours it onto the worker's cupped palms, and discards the envelope. The gowned worker powders his hands. The assistant grasps the right or left glove, turns the palm of the glove toward the gowned worker's hand, then places the fingers of each hand under the turn-back cuff, abducts the thumbs, and stretches the cuff. As the gowned worker inserts his hand into the glove, the assistant exerts a slight upward pressure on the glove, and brings the cuff over the wristlet. The same procedure is repeated for the other hand (Fig. 37) If the gown does not have a tight-fitting wristlet, the gowned worker makes a pleat in the wristlet and holds the pleat with the fingers of his other hand until the assistant secures the lower portion of the cuff

Removing Soiled Gown and Gloves

To protect the forearms, hands, and uniform from coming in contact with bacteria on the outer side of his soiled gown and gloves, the worker should carry out the steps as follows: Wash the gloved hands in the arm basin in the operating room. Using both hands, unfasten the gown. With the right or left hand, grasp the gown at the opposite shoulder. Bring the neck of the gown forward.



Fig 28.—The double-flap gown, designed by Dr C N Carraway, is shown The upper portions of the back and the front must be kept sterile. The circulating nurse ties the tapes attached to the inner flap, and the gowned and gloved worker ties the tapes sewn to the outer sterile flap (From Speed, J S, and Knight, R A Campbell's Operative Orthopaedics, St. Louis, 1956, The C V Mosby Co)



Fig. 33.



Fig. 34.

Fig. 33.—When the cuff of the gown is loose, the gowned worker makes a pleat at the bottom of the wristlet of one sleeve, holds the pleat with the gloved thumb of one hand, places the fingers of the same hand under the turned-back cuff, and brings it over the pleat, making sure to remove the thumb as soon as the bottom part of the pleat is secured.

Fig. 34.—The gowned worker brings the cuff of the glove over the upper part of the wristlet by slightly separating the fingers under the turned-back cuff and by rotating the arm externally and internally.



Fig 35.



Fig 36

Fig 35.—To bring the turned back cuff on the other hand over the wristlet of the gown, the worker repeats the steps shown in Figs 28 and 29 When the wristlet fits snugly it is not necessary to make a pleat before the turned back cuff is brought over the wristlet.

Fig 36.—The gloved worker adjusts the fingers of the glove and removes the excess powder, using a wet gauze sponge

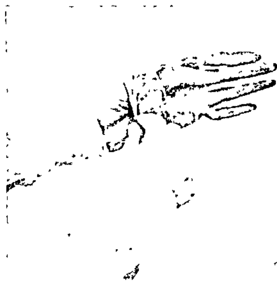


Fig 29.

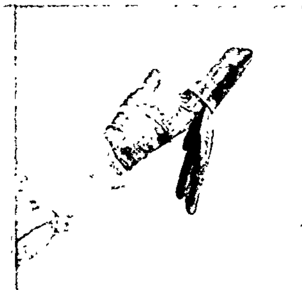


Fig 30.

Figs 29-36—Putting on sterile gloves; eight steps

Fig. 29—The gowned worker takes one glove (right or left) from the muslin envelope by placing the fingers of the opposite hand on the fold of the everted cuff at a point in line with the glove's palm, and pulls the glove over the hand, leaving the cuff turned back.

Fig 30—The gowned worker takes the second glove from the muslin envelope by placing the gloved fingers under the everted cuff

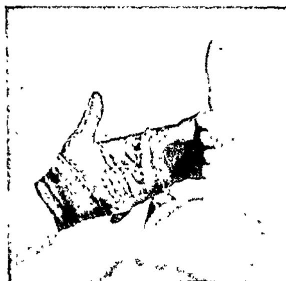


Fig 31



Fig 32

Fig 31—The gowned worker, with the arms extended and elbows flexed slightly introduces the free hand into the glove

Fig 32—The gowned worker, with fingers under the cuff of the glove, draws it over the cuff of the gown

over, and off the gloved hand. Reverse the procedure for the other shoulder, pulling gown completely off. Keeping the arms away from the body, fold the outside surface of the gown inward, and discard it in the linen hamper. Grasp the outer side of one glove with the fingers of the other hand, pull it off, and place it in the receptacle. Place bare fingers under inner side of glove, pulling it off and placing it in the receptacle. (Figs. 38 to 41.)

Unfasten face mask and discard in mask bag (Chapter 2). *Wash hands* and forearms. When the worker is to scrub for another operation immediately, he puts on a fresh mask and scrubs his hands and forearms for the prescribed time.



Fig 40



Fig 41.

Figs 38-41.—Removing soiled gown and gloves; four steps.

Fig. 38—To protect the uniform and the arms from bacteria which are present on the outer side of the soiled gown, the gowned and gloved worker peels the gown off one side of the body, using the opposite hand, and turns the inner side of the gown outward

Fig 39—The scrubbed worker turns the outer side of the soiled gown away from the body, keeping the elbows flexed and the arm away from the body, so that the soiled gown will not touch the arms or uniform.

Fig 40—To prevent the outer side of the soiled gloves from touching the skin surfaces of the hands, the worker places the gloved fingers of one hand on the outer side of the glove, then pulls it off the hand and fingers.

Fig 41—To prevent the skin of the ungloved hand from touching the outer side of the soiled glove, the worker grasps the inner side of the cuff and then pulls the glove off.

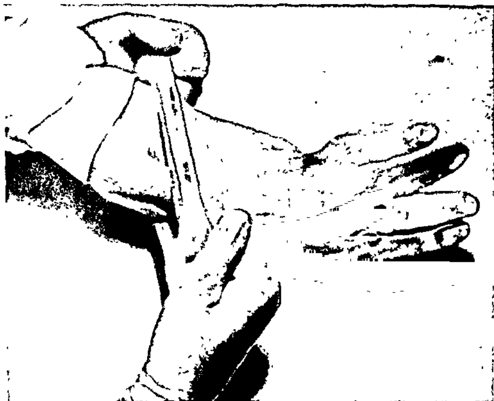


Fig 57.—Sterile gloves The gowned and gloved worker places the fingers of each hand beneath the cuff, keeping the thumbs turned outward and stretching the cuff as the gowned worker slips his hand into the sterile glove, using a firm downward thrust. (From Maes, V., and Ilgenfritz, H C Aseptic Surgical Technic, in Lewis Practice of Surgery, vol. I, Hagerstown, Md, 1955, H. F Prior Co, Inc)



Fig 58



Fig 39.

(For legends, see opposite page)

30. Deming, Emily: Lessons in Good Housekeeping—Basic Technics, Mechanical Scrubbing, Mod. Hosp. 84:150, March, 1955; 85:152, Dec., 1955.
31. Kuehn, R. P.: Who Should Do the Surgical Preparation of the Skin, Mod. Hosp. 85:81, Dec., 1955.
32. Brodie, J., Kerr, M. R., and Somerville, T.: Hospital Staphylococcus. Comparison of Nasal and Faecal Carrier States, *Lancet 1:19, 1956.*
33. Torrey, Frances: Care of the Normal Skin, Am. J. Nursing 53:160, April, 1953.
34. Postlethwait, R. W., and others: Absorable Starch Glove Powder, Am. J. Surg. 25:510, 1949.
35. Seelig, M. G: The Talcum Powder Evil, Am J Surg 76:272, 1948.
36. Lee, C. M, Jr, Collins, W. T., and Largen, T. L.: A Reappraisal of Absorbable Glove Powder, Surg Gynec. & Obst. 95:725, 1952.

REFERENCES

1. Cole, W. H., and Elman, R.: Textbook of General Surgery, ed. 6, New York, 1952, Appleton-Century-Crofts, chap. III.
2. Lawrence, H.: The Care of Your Skin, Boston, 1955, Little, Brown & Co.
3. Maes, U., and Ilgenfritz, H. C: Aseptic Surgical Technic, in Lewis' Practice of Surgery, Hagerstown, Md, 1955, W. F. Prior Co, vol. I, chap. 7, pp 8-20.
4. Best, C. H., and Taylor, N. B: The Physiological Basis of Medical Practice, ed. 5, Baltimore, 1950, Williams & Wilkins Co.
5. Carter, C F., and Smith, A. L.: Microbiology and Pathology, ed. 6, St. Louis, 1956, The C V. Mosby Co
6. Howe, C. W: Prevention and Control of Postoperative Wound Infections, Owing to Staphylococcus Aureus, New England J. Med 255:787, 1956
7. Meleney, F L.: Bacteriological and Immunological Aspects of Surgery; in Nelson's Loose-Leaf Surgery, Kernan, J. D. (ed), New York, 1955, Thomas Nelson & Son.
8. Wilson, G S, and Miles, A. A: Topley and Wilson's Principles of Bacteriology and Immunity, Baltimore, 1955, Williams & Wilkins Co, chaps 6, 7, 15.
9. Price, Phillip B: Bacteriology of Normal Skin, J. Infect. Dis 63:301, 1938.
10. Price, Phillip B.: Surgical Antiseptics, in Reddish, G. F: Antiseptics, Disinfectants, Fungicides, and Chemical and Physical Sterilization, Philadelphia, 1954, Lea & Febiger, chap. 15.
11. Reid, D. E, Walter, C. W., and Buck, A. S.. Surgical Scrubbing With pHisoderm G-11 as Applied to a Maternity Hospital, Surg. Gynec. & Obst. 91:537, 1950.
12. Henderson, Virginia: in Harmer, B. L: Textbook of the Principles and Practice of Nursing, ed. 5, New York, 1955, The Macmillan Co
13. Morris, G E.: Synthetic Detergents, Their Chemical and Dermatological Aspects, A. M. A. Arch. Dermat. & Syph. 72:43, 1955.
14. Walter, C. W: Scrubbing for Surgery, Am J Nursing 52:188, Feb, 1952.
15. Walter, C. W: Preoperative Skin Preparation, Hosp. Topics 30:71, Oct, 1952; 31:67, Jan, 1953; 32:71, May, 1954; 33:6, 90, June, 1955; 33:74, Sept., 1955; 34.95, April, 1956.
16. Walter, C W: The Aseptic Treatment of Wounds, New York, 1948, The Macmillan Co.
17. Guild, B T.: Cutaneous Detergents. Experience With Ether-Sulfonate Compounds, Arch. Dermat & Syph 51:391, June, 1945
18. Zintel, H. A: Asepsis and Antiseptics, S Clin. North America 4:257, 1956
19. Freeman, B S., and Young, T. K.: Clinical Study of the Use of a Synthetic Detergent (pHisoderm) Combined With Hexachlorophene, Arch Surg 61:1145, 1950.
20. Thomas, E G., and McCutcheon, J W: Soaps and Detergents, New York, 1949, MacNair-Dorland Co, Inc.
21. Allers, O. E, Hubbell, J P., and Buck, A S: A Rapid Aseptic Scrub for Nurseries of the Newborn, Am J Obst & Gynec 60 431, 1950.
22. American Medical Association, Council on Pharmacy and Chemistry: Hexachlorophene, J. A. M A 145:563, 1951.
23. Bowers, R. F pHisoderm With Hexachloraphene (G-11), Am J Surg 81:580, 1951.
24. Cade, A R, and Gump, W S. The Bis-phenols; in Reddish, G F.: Antiseptics, Disinfectants, Fungicides, Chemicals and Physical Sterilization, Philadelphia, 1954, Lea & Febiger, chap 12
25. Buck, A. S, and Reid, D E: The Bacteriostatic Activity of pHisoHex on the Vaginal Flora, Am J Obst. & Gynec 65:358, 1953.
26. Zintel, H. A, Ellis, H, and Garcia, M: Observations After One Year's Use of pHisoHex; the Use of Brushes and Hand Dips, Forum 4:617, 1953
27. Berry, Edna C, and Kohn, Mary L. Introduction to Operating Room Technique, New York, 1955, McGraw-Hill Book Co, Inc.
28. Gershenfeld, L.: Iodine, in Reddish, G F: Antiseptics, Disinfectants, Fungicides, and Sterilization, Philadelphia, 1954, Lea & Febiger, chap 6.
29. Fuerst, E. V, and Wolff, L: Fundamentals of Nursing, Philadelphia, 1956, J. B. Lippincott Co.

30. Deming, Emily: Lessons in Good Housekeeping—Basic Technics, Mechanical Scrubbing, Mod. Hosp. 84:150, March, 1955; 85:132, Dec., 1955.
31. Kuehn, R. P.: Who Should Do the Surgical Preparation of the Skin, Mod. Hosp. 85:81, Dec., 1955.
32. Brodie, J., Kerr, M. R., and Somerville, T.: Hospital Staphylococcus. Comparison of Nasal and Faecal Carrier States, Lancet 1:19, 1956.
33. Torrey, Frances: Care of the Normal Skin, Am. J. Nursing 53:160, April, 1953.
34. Postlethwait, R. W., and others: Absorable Starch Glove Powder, Am. J. Surg. 25:510, 1949.
35. Seelig, M. G.: The Talcum Powder Evil, Am. J Surg. 76:272, 1948.
36. Lee, C. M., Jr., Collins, W. T., and Largen, T. L.: A Reappraisal of Absorbable Glove Powder, Surg. Gynec. & Obst. 95:725, 1952.

CHAPTER 4

STANDARD NURSING PROCEDURES IN SURGERY

A procedure is correct if it conforms to the principles of medical and surgical asepsis, provides for the safety and comfort of the patient, considers the economy of the personnel's time and energy, and conserves materials.

Before modern aseptic surgery and anesthesiology were instituted, the more rapidly the members of the operating team carried out their duties, the better it was for the patient. Quick surgery was of vital importance for a patient's successful recovery. In those days the operators did not scrub their hands or put on sterile gowns and rubber gloves, and all items which came in contact with the wound were contaminated. Since the development of anesthesia, asepsis, efficient instruments, and modern physical facilities, there is less value attached to speed during surgery. It is now essential that each member of the team perform his or her duties as quickly as is consistent with the safety, dignity, and comfort of the patient, as well as with asepsis and economy.

To provide adequate care at reasonable cost for the patient undergoing surgery and to maintain the morale of the workers at a high level, the professional workers must accept their responsibilities for formulating safe procedures, evaluating them at periodic intervals, and instructing their co-workers in how to perform their duties.

ADMINISTRATIVE PLANNING

Even though the graduate operating nurses accept their responsibilities pertaining to the care and handling of equipment there are responsibilities for the direct care of the patient, standardization programs and research projects that can only be instituted with the concerted efforts of all persons who are directly or indirectly involved. Each program must have a common purpose or plan. It must be well organized, completely understood, and accepted by the members of the operating room staff and allied professional workers [1-4]

A Cooperative Plan.—The most efficient results of any managerial, inservice educational, or training program are usually obtained when the over-all responsibility is delegated to a representative group.[3,5-8] The composition of the committee or group will always depend upon the size, type, and organizational structure of the hospital and the program or procedure to be instituted. The operating room nursing staff and the surgical staff require expert assistance from personnel in other departments in the hospital, since modern operating

room units comprise a network of interrelated and interdependent parts within the hospital regardless of the size and kinds of services given in the operating room.[9,11] To produce good results this cooperative approach must exist within an accepted structured organizational pattern.

Committees.—The surgical committee may include the operating room supervisor, representatives of the head nurse group, the operating room clinical instructor, a senior attending surgeon of each service, the chief physician of anesthesiology, representatives of the resident or assistant residents in surgery, and the hospital and nursing service administrators. Resource members should include the heads of allied departments, such as central service, bacteriology, radiology, purchasing, maintenance, and nursing education. The functions of this group, and those of any such committee, should be clearly defined and understood by all members of the staff (Chapter 1). The over-all functions of any operating room committee should include: (1) recognizing the different aspects of problems; (2) evaluating all suggestions presented; (3) securing reliable information; (4) understanding each other's role and problems; (5) accomplishing a change of procedure rapidly and with ease; (6) getting approval of written recommendations and following through; (7) helping to interpret changes and new procedures to others and gaining their acceptance.[12-15]

It is also necessary that the members of a group follow rules so that time will not be wasted. Such rules include: (1) electing a chairman (leader); (2) determining lines of communication; (3) setting a definite time and place for meetings; (4) preparing a plan of action and an agenda for periodic conferences as needed; (5) recording minutes of conferences and sending copies to all persons directly concerned; (6) presenting written recommendations to the proper authority and following through.

In some hospitals the over-all responsibility for standardization of operating room procedures and techniques is delegated to a surgical committee (operating room committee). And the operating room supervisor should be a member of the nursing executive committee, a resource person to the professional committees on supplies of the hospital and safety measures. The operating room inservice educational and training program committee should work with the director in charge of the hospital's educational and orientation programs. All members of the operating room staff should work through and with the delegated groups for improving procedures and techniques. The graduate nurse in charge of each service should be given the freedom in which to work and develop her own ideas and those of other members of the team.

OPERATING ROOM STANDARDIZATION PROGRAMS

To provide adequate services to patients in surgery, the operating room teams and administrator should agree upon a plan of action whereby a sufficient number of setups, including instruments, textiles, and other commodities, will be available to care for patients with various conditions.

Developing and Appraising a Plan.—The plan should include:

1. Maintaining a sufficient number of setups (instruments, draping sheets, sutures, drains, gauze sponges, and so forth) to care for the patients in each operating room unit during a daily schedule.

2. Selecting the design and equipment which have proved to be most efficient for a particular situation, and selecting those sizes most frequently used by several services. For example, select two sizes of regular draping sheets and the types of fenestrated sheets suitable for use in several types of surgery. Determine the types and sizes of sutures for average needs and use swaged-on needles rather than eyed needles (Chapter 5). Select a large-sized gauze sponge, bandage, and adhesive tape rather than two or three smaller sizes within the same range.

3. Determining the contents and number of different items to be assembled in the sterile packs for various types of surgery (Chapter 2).

4. Selecting one or two detergents and chemicals for disinfecting equipment, and one or two antiseptics for cleansing the operative skin area.

5. Compiling a list of all pieces of equipment in the department, noting the correct terminology and catalog number of each item.

6. Replacing obsolete equipment and securing additional apparatuses according to a budgetary plan approved by the surgical committee and standard committee of professional supplies.

7. Selecting pieces of equipment that can be serviced readily by a nearby supplier.

8. Consulting with the purchasing agent and representatives of reliable manufacturers concerning the latest developments of products and future trends. Studying the reports of research and methods of work simplification pertaining to apparatuses and work patterns followed in other operating rooms.

9. Compiling a file system for pieces of equipment on order—those received and those to be purchased.

10. Compiling a reference file for different setups, noting on the cards the surgeons' perferences for each type of case.

11. Evaluating the personnel's written suggestions, making necessary changes, and recording changes in the reference file and in the procedure book.

12. Interpreting changes in setups, orally and in writing. Demonstrating the care and handling of new complex and expensive pieces of equipment to the operating room nursing and surgical staffs.

Determining Number of Setups Needed.—In some hospitals, it may be necessary for the operating teams in each unit to do a three- to six-month survey to determine the different items now being used in caring for the patients. In some units, this study may include gathering information on fifteen or more similar operations in order to obtain an accurate picture of the daily average needs. The information should be recorded on mimeographed forms so that the collected data from all units can be tabulated and analyzed. A form (14 inches wide and 10 inches long), divided lengthwise into ten or more columns, has proved to be satisfactory. At the top of the form, the space is labeled "Date," "Type of Operation," and "Name of Surgeon and Graduate Nurse." The headings of the columns may include "Number and Type of Retractors," "Hemostats," "Sutures," "Draping Sheets," and "Comments." The observer fills in the information at the top of the form and records in the columns the number and name of the item used.

After the data have been analyzed, the committee is ready to list those items needed for various operations. The setups are then used and necessary changes are made. With the approval of the surgical committee, the standard setups are instituted according to the agreed plan.

The specific number and kinds of setups to be allocated to each operating room unit depend on the number of patients operated upon each day for similar conditions.[16-21] A unit where general surgery is to be performed may need one minor and two major setups, also setups for operations on the neck, gall bladder, and gastrointestinal system (Chapters 8, 12, 13, and 14). The minor setup should be sufficient for an inguinal hernial repair (Chapter 11), and the thyroidectomy setup would be used with this setup (Chapter 8). The major setup would be used in conjunction with the gall bladder or the gastrointestinal setup. A rectal setup would be used with the minor or major setup, depending upon the type of operation to be performed (Chapter 14).

To care for gynecologic patients, the unit may need five or six setups. These may include the following: a dilatation and curettage setup, two vaginal setups (minor and major), a major abdominal setup, and a setup for implantation and application of radium or radon (Chapter 15).

The neurosurgical (Chapter 6), endoscopic (Chapter 9), nose and throat (Chapter 8), orthopedic (Chapter 17), and thoracic services (Chapters 10 and 11) usually need two or three setups for operations and diagnostic procedures.

Advantages of Standard Setups.—Instituting such a program may require purchasing some additional equipment; if so, it is true that the advantages gained outweigh the initial expense. In many hospitals, standard surgical setups can be assembled with little expense by taking a complete inventory and reorganizing and reassembling the available resources.

Standardization of setups helps to control the supply of equipment, provides an accurate system for keeping an inventory up to date, and reduces the number of pieces lost or damaged. It also helps to shorten the period between operations, and makes for a more contented staff. Such a system eliminates the necessity for nurses to look for necessary items between operations, or for the operators to work with incomplete setups. The instruments can be cleaned and reassembled immediately after use. This eliminates the need to sort and assemble many setups at the end of the daily schedule. It should also be noted that in planning for new physical facilities, such a program should be instituted (Chapter 1)

PROVIDING ADEQUATE INSTRUMENTS AND SUTURES

Through a planned program the professional members of the hospital team should determine the quantity and quality of the various instruments needed for the setups.

Selecting Instruments and Sutures.—Proper instruments and other tools should be available, of good quality, and in good working condition. It is not only disturbing to the operators to have to use a dull knife and dull scissors, inadequate clamps, and retractors, but it is also unfortunate for the patient.[22-30] Dull instruments are dangerous because the operator must use undue effort to

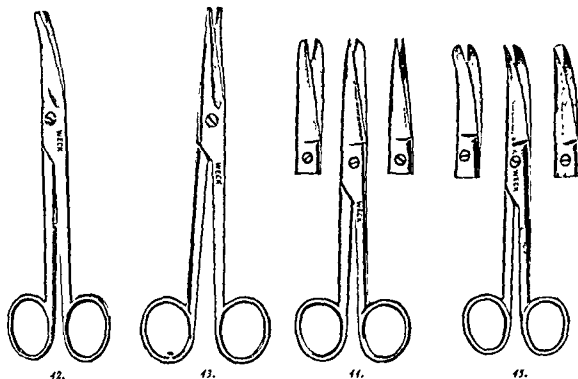


Fig [illegible] on flat, 5½ inches
Fig [illegible]ht, 5½ inches.
Fig. [illegible] straight, 4½ inches.
Fig 45.—Dressing and operating scissors, curved on flat, 5½ inches.

46 47 48 49.

Fig 46.—Bandage scissors, 5½ inches
Fig. 47.—Moore nail and wire cutters.
Fig. 48.—Metzenbaum tonsil scissors, curved, 7 inches
Fig. 49.—Strabismus scissors, blunt points, 4¾ inches, curved or straight.
(Courtesy Edward Weck & Co, Inc., Brooklyn, N.Y)

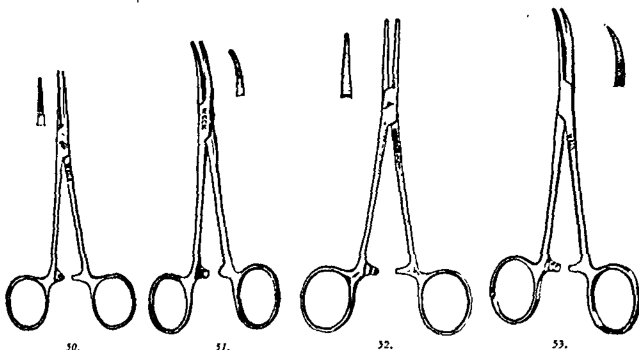


Fig. 50.—Mayo-Kelly hemostatic forceps, 5½ inches, straight jaw, box lock.
Fig. 51.—Mayo-Kelly hemostatic forceps, 5½ inches, curved jaw, box lock.
Fig. 52.—Mayo-Crile hemostatic forceps, 5½ inches, straight jaw, box lock.
Fig. 53.—Mayo hemostatic forceps, 5½ inches, curved jaw, box lock.

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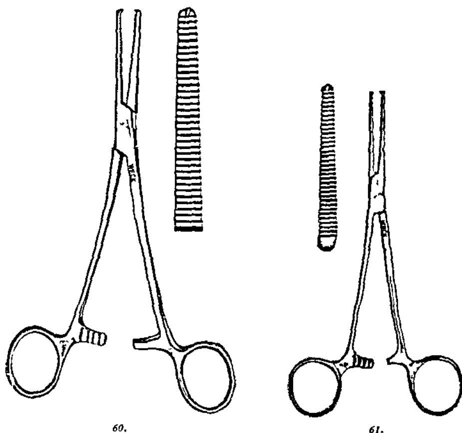
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56.

Fig. 54.—Mayo-Pean hemostatic forceps, 6½ inches, curved jaw, box lock.
Fig. 55.—Mayo-Carmalt hemostatic forceps, 7½ inches, curved jaw, box lock.
Fig. 56.—Mayo-Ochsner hemostatic forceps, 5½ inches, curved jaw, box lock.
(Courtesy Edward Weck & Co., Inc., Brooklyn, N.Y.)

57. 58. 59

Fig 57.—Babcock intestinal forceps, 6 inches, box lock.
Fig 58—Allis tissue forceps
Fig 59—Crile-Wood needle holder, 6¼ inches long



60. 61.

Fig 60—Mayo-Ochsner hemostatic forceps, 7¼ inches, straight jaw, box lock
Fig 61—Kocher hemostatic forceps, 5¼ inches, straight jaw, box lock.
(Courtesy Edward Weck & Co, Inc., Brooklyn, N Y)

divide tissues and it is difficult for him to accurately determine the force and direction of a cut. (Figs. 42 to 45.)

Since scissors cut more by the shearing action of one blade passing over the other than by their actual edges (as in a knife or chisel), the blades of the scissors must be properly set with smooth, rust-free inner surfaces. For this reason well-designed stainless steel blades are preferable, since they do not rust and will give longer service. Certain designs and sizes of scissors are needed to perform specific procedures.[10,22] The proper type and size should be used for its designated purpose; that is, bandage scissors are used for cutting gauze compresses and bandages, suture scissors are used for preparing suture strands (Figs. 46 to 49); blunt-pointed scissors are needed for dissection or dividing soft tissue.

Hemostatic clamps and forceps are designed to assist the operators in clamping, ligating, and closing blood vessels, for grasping lesions, and for approximating tissue layers to be sutured. The jaws of the hemostat must meet, and the serrations must mesh properly. They are beveled along the edges to prevent further trauma to the tissues. The shank should be flexible, yet strong and steady, to permit graduated pressure supplied by the several catches on the shank.

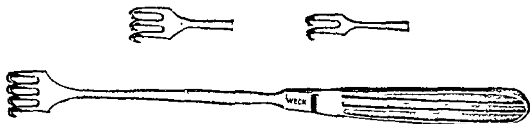


Fig 62 —Volkman retractor, 2 to 4 prongs, blunt or sharp



Fig 63 —Richardson retractor, blade various widths
(Courtesy Edward Weck & Co, Inc, Brooklyn, N Y.)

When the forceps are closed, the catches must hold securely and should slide smoothly over each other. A box-lock construction is preferred since it provides support to both sides of the forceps and it helps to prevent the shank from bending To reduce the abuse to which forceps are subjected, the necessary instruments should be available for the procedure. If a rubber catheter or a piece of tubing must be clamped with a hemostat, the tube should be placed away from the joint of the forceps.

When hemostats and clamps are not in use and when they are prepared for sterilization, the jaws should be free or should be closed on only the first catch. The soiled hemostats should be cleansed immediately after use (Chapter 2). Common and general types of instruments are shown in Figs. 50 to 81.

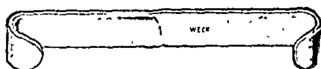


Fig 64.—Parker retractor.



Fig. 65—Mayo Collins retractor.

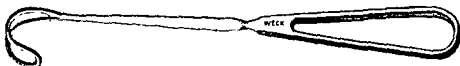


Fig 66.—Greene retractor.

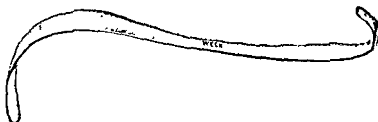


Fig 67—Deaver retractor, long, 1 inch wide, 10 inches long

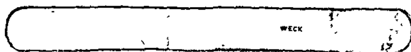


Fig 68—Flexible copper retractor, various widths.

(Courtesy Edward Weck & Co, Inc, Brooklyn, N.Y.)



Fig. 69.—Deschamps aneurysm needle, right or left, sharp or blunt.

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Fig 70—Probe, with eye

Fig 71—Director and tongue tie

Fig 72—Poole suction tube

Fig 73—Knife handles and blades

(Courtesy Edward Weck & Co, Inc, Brooklyn, N Y)

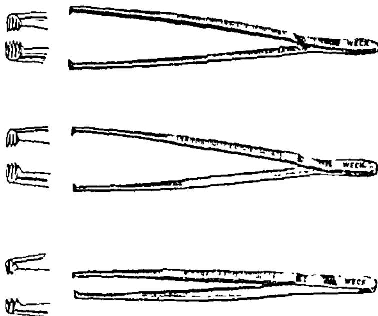


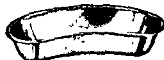
Fig. 74.—Tissue forceps with teeth.



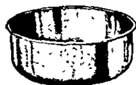
Fig. 75.—Tissue forceps without teeth.



Fig 76.—Splinter forceps, plain, 3½ inches



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Fig 77.—Sponge bowl, stainless steel.
Fig 78.—Graduate medicine cup, stainless steel
Fig 79.—Solution bowl, stainless steel
Fig 80.—Pus basin, stainless steel
Fig 81.—Catheter tray with cover

(Courtesy Edward Weck & Co, Inc, Brooklyn, N.Y)

Sutures.—The care and handling of suture materials is described in Chapter 5. The nursing members of the team should prepare four free ligatures and one suture before the patient arrives. The other sutures can be prepared during the operation. However, a sufficient number of sutures in packages or on reels should be on the instrument table according to the suture listing on the card file for the particular operation.

Handling Sterile Instruments to the Surgeon.—The elimination or better arrangement of body motions serves to reduce fatigue and to make the work easy. When the scrubbed nurse positions and hands instruments to the surgeon, she should use forearm, wrist, and finger motions, since less energy is involved. Finger motions are the least complex. Smooth, continuous motions of both hands are preferable to straight-line motions involving sudden, sharp jerks or changes in direction (Fig. 82).



Fig 82—To hand a ringed instrument to the surgeon, the gowned and gloved nurse holds the instrument in a position in which he can grasp it ready for use The surgeon extends his hand, flexes his ring finger and thumb slightly so that the rings of the forceps can be gently placed over them

The scrubbed nurse watches the operative field and tries to anticipate the surgeon's needs Stability of the body is assured by keeping the center of gravity over the base. Good posture helps the nurse to work more effectively and safely with less fatigue.

STANDARDIZATION OF DRAPING SHEETS AND PROCEDURES

To provide a sterile field during the operation, the patient must be covered with sterile sheets in such a way that only the proposed operative site is exposed. A simple, efficient draping procedure aims to maintain asepsis, permit adequate exposure of the area to be incised, ensure the safety and comfort of the patient, provide for economy of materials and storage space, and conserve operating time.[2,13,22-25,28-34]

The operating room nursing staff with the assistance of the surgical staff should design and determine the types of sheets to be used, the number and types to be assembled in each pack, and the number of packs needed for the various operations (Chapters 6 to 17).

The professional personnel who care for patients in surgery are responsible for providing a step-by-step description of each draping procedure and for evaluating and revising such procedures so that they conform to the latest accepted aseptic standards and work-simplification methods.

Selecting Types of Sheets Needed.—To determine the types of sheets required for use in various operations, the personnel should consider the following factors: the quality, thickness, and dimensions of the draping material must prevent contamination of the wound, permit exposure of the proposed line of incision, and allow the anesthetist, the circulating nurse, and other assistants freedom to carry out their duties without fear of contaminating the sterile field.

A draping sheet which is made of two thickness of fine muslin allows for complete penetration of steam during sterilization. Materials such as canvas, heavy twills, or heavy, unbleached muslin should not be used because they retard the sterilization process, increase laundry and maintenance costs, require considerable storage space, and make handling difficult and sometimes unsafe. Although a patient loses little heat by natural convection, a heavy sterile sheet placed over him usually stops any or all natural convection. The patient is less likely to perspire excessively if a light drape is used.[35]

A drape made of two thicknesses of fine, durable sheeting has several advantages as compared to a single sheet. One double-thickness sheet not only provides adequate protection but also reduces the time needed to launder, package, sterilize, and apply the sterile sheets (Figs. 3 and 4). A double-thickness sheet, however, may not be practical or feasible when preparing newborn infants and young children for surgery or when preparing adults for operations on the face, joints, or extremities In such cases, single sheets should be used, and the immediate area surrounding the proposed operative site should be reinforced with sterile towels or additional small sheets (Chapter 17).

Some hospitals have found the use of waterproof single sheets to be satisfactory. The data collected seem to indicate that a waterproof disposable sheet may be on the market at a reasonable price in the near future.

Sheets and towels of two sizes should be used rather than several sizes. Small sheets, each 24 inches wide and 30 inches long, or 36 inches wide and 45 inches long, are usually adequate to cover furniture, to drape a newborn infant or a young child or to wall off a prepared skin area. To drape adult patients for

extensive thoracic or orthopedic operations, the foundation sheets and uppermost regular sheets should be of sufficient size to cover the patient and table. A large sheet, which is about 72 inches wide and 108 inches long, will extend from the lower end of the operative site to below the foot of the operating table. In some hospitals a fenestrated sheet is used rather than two regular sheets.

Sheets with an opening (window or slit) should be used whenever possible, since they cover the patient except for the area in which the incision is to be made, and conserve both the personnel's time and maintenance costs. This sheet should be of sufficient size to cover the anesthetist's screen, the patient, and the Mayo stand, and extend below the sides and foot of the operating table (Fig. 83).

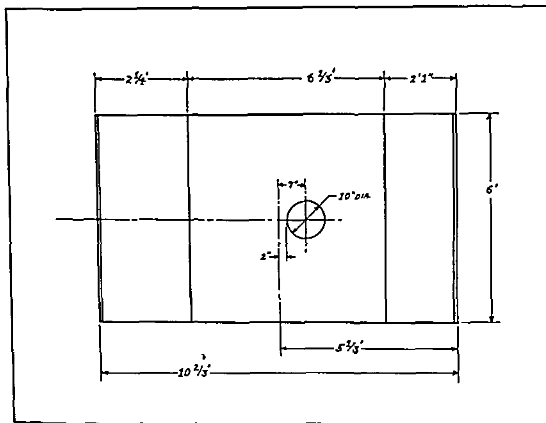


Fig 83 —A fenestrated (laparotomy) sheet used to drape the patient who is to have an abdominal, kidney or some type of chest operation

A piece of regular sheeting should be sewn to one or both sides of the sheet at the top so that the flaps will cover the arms extended on the arm rests when the sheet is draped over the patient. A wide area surrounding the opening in the sheet should be reinforced *with two thicknesses of sheeting.* The dimensions of the opening must afford the surgeon sufficient exposure of the proposed operative site and be suitable for the type of incision to be made.

In the laparotomy sheet, the opening (about 9 inches in diameter) is usually located 50 inches from the top of the sheet (Fig. 94) This sheet can be used for most abdominal operations, nephrectomy, or simple mastectomy. For some types of kidney operations, a fenestrated sheet with a transverse opening is preferred. The thyroidectomy sheet, commonly used, is made with a transverse slit, and

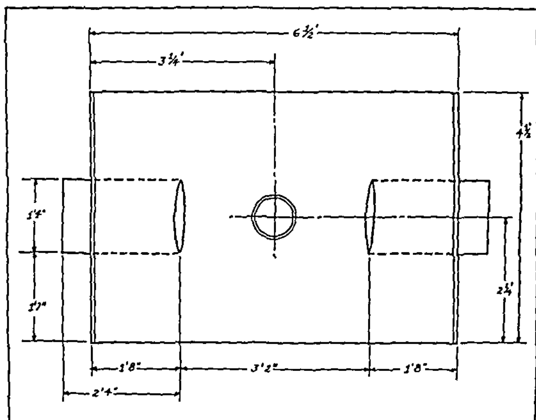


Fig 84 —A perineal sheet used to drape the patient who is placed on the operating table in a lithotomy position The leggings are sewn into the sheet.

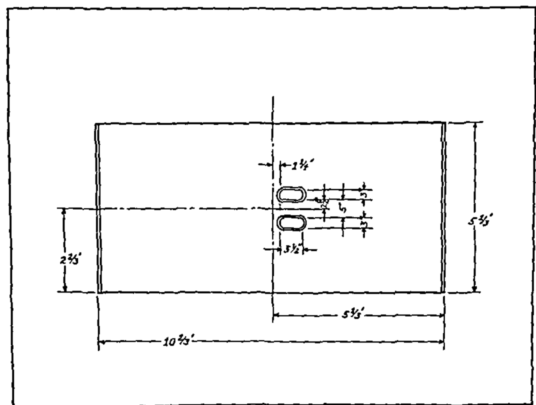


Fig 85 —A fenestrated sheet used to drape the patient who is to have a high saphenous vein ligation

cotton tapes are sewn to each end of the slit. In surgery the tapes are secured at the back of the patient's neck, thereby keeping the edges of the opening against the skin (Chapter 7).

For thoracic operations on adult patients, the fenestrated sheet may be made with a flap extending from each side at the uppermost end. The top of the sheet is about 140 inches wide (each flap measuring 36 by 32 inches), and the bottom of the sheet, about 61 inches wide. The opening of the sheet, which is about 10 by 13 inches, is located about 25 inches from the top of the sheet.

The left or right fenestrated radical mastectomy sheet is made with a flap extending from the left or right side. The opening, which is located about 30 inches from the top of the sheet and 5 inches from the center of the sheet, is oblong in shape and of sufficient diameter to expose the entire breast and the axillary region.

The fenestrated perineal sheet is used when the patient is in lithotomy position. This sheet (72 inches wide and 90 inches long) has leggings sewn into it (Fig. 84).

In a hip sheet for an adult, the opening is usually larger than that of a laparotomy sheet, and is located about 55 inches from the bottom of the sheet. For a high saphenous vein ligation a fenestrated sheet with two small openings may be used (Fig. 85).

Packing the Sheets for Use.—The sheet should be folded so that the gowned and gloved members of the team can handle it with ease and safety. The larger, regular sheet is usually fan-folded from bottom to top, with the bottom fold four inches wider than the upper folds. The small sheet is folded in half and then quartered, and the top corners of the sheet are turned back.

Most fenestrated sheets are fan-folded to the opening from the top and the bottom, and then the folds are rolled toward the center of the opening (Figs. 83, 85, and 91). The edge of the top fold of the sheet is fanned so that it provides a cuff under which the operator can place his or her gloved hands. The top portion of the sheet is fanned in narrower folds than that of the lower section so that the top section can be easily identified from the bottom, thereby eliminating the need to identify the top section by means of a marking.

Orienting the Staff.—The orientation program of the nursing staff and the assistant surgical staff should include demonstrations of all standard draping procedures as adopted by the department.[7,8,13,36,37] The written step-by-step description of each draping procedure should be compiled in the nursing procedure book. Copies of the standard draping procedures and diagrams of the steps should be given to the inexperienced graduate nurse and the nursing student during classes on aseptic techniques and operating room nursing.[3,4]

Developing Skills in Draping the Patient With Sterile Sheets.—The gowned and gloved members of the team apply the principles of asepsis and body mechanics as they drape the patient with sterile towels and sheets.[2,13,21] The type and preparation of sheets have been described previously. Suggested procedures for draping extremities are described in Chapter 17.

The general rules for draping procedures include the following: (1) The cleansed operative site should be surrounded with sterile towels. (2) A fold of the sheet or towel should be placed on the prepared skin area, then the remaining portion draped over the patient. (3) Sheets or towels should be placed (not dragged) over the field. (4) The draper protects his gloved hands from an unsterile field by keeping them under a protective cuff made of the sheet or towel. (5) The draper should keep the upper fold of the sheet at eye level, and should place the folded sheet on the sterile field; then it should be opened over the patient. (6) The draper should never reach across an unsterile area to place a sheet on the opposite side. The method for opening a towel and a fenestrated sheet is shown in Figs. 86 to 94.

Fig 86 Fig. 87.



Fig 88.

Fig 86.—Opening a towel To conserve energy and operating time, the towel is folded in half lengthwise and quartered The gowned and gloved worker grasps the towel at the fold, places the thumb and forefinger of each hand at the ends, about four inches from the upper side

Fig 87.—Opening a towel—cont'd The gowned and gloved worker abducts the arms, allowing the fold to fall onto the underside of the towel

Fig 88.—Placing the towel on a sterile surface or a cleansed skin area, the gowned and gloved worker rotates the arms inward to provide a protective cuff over the gloved hands, and then places the towel on the area, keeping gloved hands and gown a safe distance away.

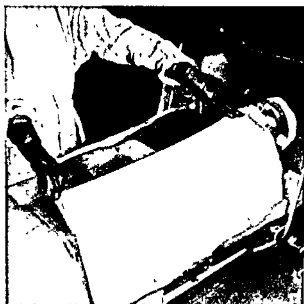


Fig. 89 —To surround the cleansed skin area with sterile towels, the gowned and gloved worker protects the gloved hands from the nonsterile area.

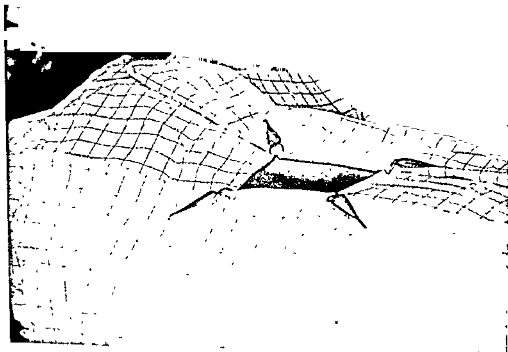


Fig 90 —Draping the operative field The skin area through which the incision is to be made is outlined with towels which are then held in place with towel forceps (From Maes, V, and Ilgenfritz, H C Aseptic Surgical Technic, in Lewis' Practice of Surgery, vol. I, Hagerstown, Md, 1955, H. F. Prior Co, Inc)



Fig 91 —When a patient is draped with a laparotomy (fenestrated) sheet, the gowned and gloved worker holds the rolled sides of the sheet and places its opening directly over the incisional site (Courtesy American Cyanamid Co , Surgical Products Division, Danbury, Conn)

Fig 92 —This illustration shows the gowned and gloved worker dropping the folds on the opposite side over the table, to show that the sheet is fan folded to the opening from the top and from the bottom. In actual practice the gowned and gloved worker would drop the folds nearest her over the side of the table, then reach across the sterile sheet to open the opposite side and release it The edge of the top folds are fanned to serve as a cuff under which the draper places the gloved hands The folds of the top section are narrower than those of the bottom (Courtesy American Cyanamid Co , Surgical Products Division, Danbury, Conn)



Fig 93 —Draping the patient with a laparotomy sheet To unfold the upper section of the sheet over the anesthetist s screen, the gowned and gloved worker grasps the sheet under the top fold, keeps the gloved hands under it as she unfolds the sheet over the screen. (Courtesy American Cyanamid Co , Surgical Products Division, Danbury, Conn)

Fig 94 —Draping the patient with a laparotomy sheet. The gowned and gloved worker places the gloved hands under the top fold of the lower section of the sheet and opens it downward over the patient, allowing the end to drop down over the foot of the table. (Courtesy American Cyanamid Co , Surgical Products Division, Danbury, Conn)

DEVELOPING A TEAM CONCEPT

The Composition of an Operating Team.—The number of professional and nonprofessional personnel assigned to each team is influenced by the patient's physical and emotional problems and the type of operation to be performed. Members of the team are the patient, the surgeon, one or two assistant surgeons, the anesthesiologist, and two graduate nurses or one graduate nurse and a surgical technical aide or a practical nurse. Other allied professional workers are the bacteriologist, pathologist, radiologist, medical physician, and head nurse.

A work plan aims to ensure the safety of the patient and personnel, conserve the personnel's time, and develop mutual understanding between all members of the team.[3,6,14] It should permit each member to coordinate his own duties with those of other members of the hospital team. To assure maximum care to the patient, there must be a good relationship between the patient and those who are giving the care; between the operating room supervisor and the operating room head nurse; and between them and the head nurse in the patient's unit. A real relationship should exist between the supervisory group and the persons who are being supervised and between the supervisory group and persons in other allied departments. Nurses who wish to become operating room supervisors or instructors and those who are concerned with operating room nurses' responsibilities should study the standard textbooks concerning the administrative aspects of an operating room suite.

The Nurse's Role on the Operating Team.—The surgeon is the leader of the team. The nursing members are delegated certain responsibilities by the surgeon for the direct and indirect care of the patient. In accepting their professional responsibilities, the graduate nurses, with the assistance of other allied workers, establish a good work plan so that they can carry out their functions efficiently as individuals and as members of the team.

To accept the position of the graduate nurse on a team, the person should have a thorough knowledge of instruments and other apparatuses used to perform the proposed operation and those needed for emergency situations which may arise. The person should possess ability and skill in interpreting to others aseptic techniques and policies as adopted by the department and should be alert and aware of those procedures concerning nursing responsibilities. The person must understand the plan of work, help to coordinate the activities of all members of the team, and give direct care to the patient. An efficient plan permits the circulating nurse and the scrubbed nurse to correlate the activities of others, and, at the same time, permits themselves to perform their own duties safely, completely, and correctly.

The graduate nurse on the team should also have a general understanding of the laws and practices concerned with the care of patients in surgery. These include the consent for operation, admission of the patient to surgery, as well as sponge count record, disposition of specimens, and laws of the state concerning negligence and grounds for liability.[38-45]

The scrubbed nurse (instrument nurse or assistant nurse) is responsible for draping the furniture with sterile sheets and arranging and preparing all sterile pieces of equipment on the tables according to the plan adopted by the department. To assist the surgeons effectively, she must have a general knowledge of the anatomic structures involved and the steps of the proposed plan of treatment. To ensure safety to the patient, she must apply the principles of asepsis as she assembles and hands equipment to the surgeon. She should appreciate the importance of having the items in perfect condition and in good working order, and available when needed.

The surgical technical aide or practical nurse may take the position of the scrubbed nurse or the circulating nurse. This member should not be assigned to such a position unless he or she is adequately trained by means of a well-planned and well-organized course of instruction. The person should carry out assigned duties under the direct and continuous supervision of a qualified graduate nurse in the unit.



Fig 95 —Arrangement of sterile items on the instrument table, ready for use in a celiotomy.

After the operation is completed, the circulating nurse assists the surgeon in applying the adhesive tape. She changes the patient's gown and cotton blanket and makes sure the proper instructions are noted on the chart. She makes sure the patient is returned to the proper stretcher or bed and helps transfer him to it. She makes sure the arm, *in which the infusion is running,* is supported by a splint, and that the infusion set is secured to the holder at the foot of the stretcher (Chapter 2).[30,46,47]

The scrubbed nurse assembles the soiled instruments and discards the soiled sponges on the instrument table and Mayo stand (Chapter 2). The nursing aide

helps to care for the soiled equipment and assists the nurses in preparing the room for the next patient.

PREPARATION OF THE UNIT FOR THE PATIENT

To protect the patient against accidental injury and postoperative sepsis, the operating room nursing staff should carry out appropriate precautionary measures to help reduce or eliminate physical, chemical, or biologic hazards.

Developing a Plan of Work.—The nurses' responsibility for providing a clean environment and sterile equipment and sterile drugs are described in Chapters 1 and 2. Practices based on medical and surgical asepsis pertaining

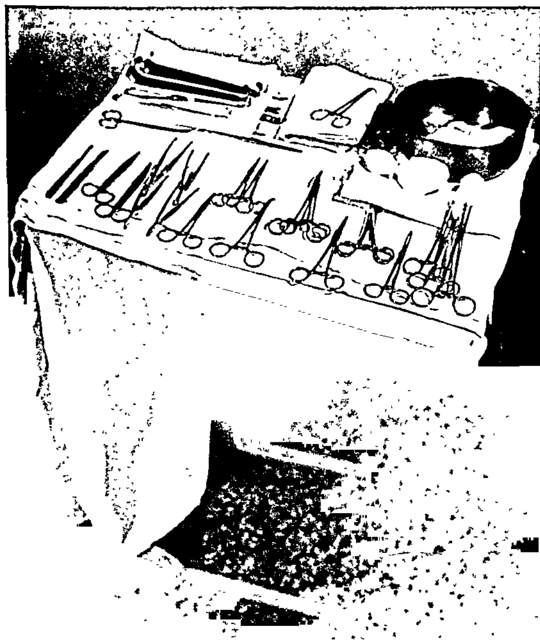


Fig 96—Arrangement of sterile instruments and other items on the Mayo (portable) stand which will be placed at the operative field during the operation.

Fig 97 — Arrangement of sterile items for a vaginal operation when a Mayo stand is not used.

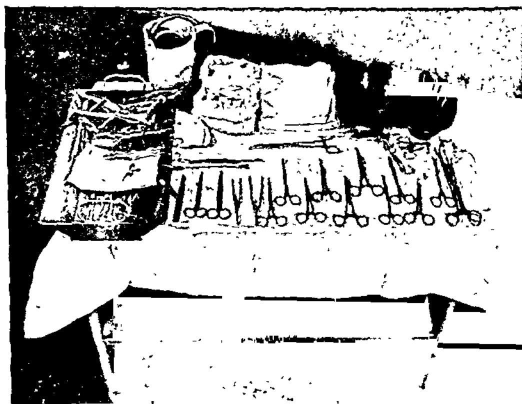


Fig. 98 — Arrangement of sterile items for a minor operation, such as a rectal operation, when a Mayo stand is not used.

to the workers' wearing apparel, disinfection of the skin, and putting on a sterile gown and sterile rubber gloves are described in Chapters 2 and 3.

Setting up the Room.—The trained technical surgical aide or nursing aide can assemble all the articles in the unit as needed for the patients listed on the morning or afternoon schedule.

The two nursing members of the operating team prepare the sterile articles for each patient just prior to his arrival. The members can carry out the preliminary preparation in about five minutes when the setups have been standardized and the workers have been well oriented to the work plan and to the arrangement of the sterile articles on the tables. The procedure book in each unit should contain a visual aid and reference unit. It may be composed of photostats or heavy cards, each 5 by 8 inches, on which is reproduced typed information and illustrations showing the arrangement of the instruments, basins, sutures, linens, and so forth, on the sterile tables (Figs. 96 to 98).

The orientation program of the operating room staff should include instruction, demonstrations, and return demonstrations on how to prepare a unit for the patient. The accepted procedures for the arrangement of articles and method of setting up units for different types of operations should be determined by the graduate nurses in charge of the units. Standardization helps to reduce errors, to conserve the personnel's time, and create a better learning environment for the nursing students.

In the orientation program the instructor teaching operating room nursing or a technical skill will focus attention on the principles of asepsis and body mechanics upon which the procedure is based. A detailed procedure of how each activity is carried out is not feasible in a general operating room textbook, since the work pattern must be suitable to the operating room facilities and the needs of the patient in the hospital. Detailed procedures should be defined and followed by the personnel in each institution.

Developing Technical Skill.—There is a core of action in the preliminary technical procedures which is common in many situations.[8,13,16,30,18] For example, in teaching personnel the suggested procedures for setting up a unit may be presented as follows:

Opening a Large Pack (Laparotomy)

Aim: To turn back the unsterile outer wrapper so that the gowned and gloved worker can handle sterile contents of the pack.

Suggested Steps:

1. *Circulating Member* Places the instrument table and Mayo stand in the room so that they are several feet from the walls and other objects and near the area where the operation will be performed. Adjusts the height of the Mayo stand to suit the scrubbed worker. Places the pack on the Mayo stand so that the uppermost flap faces

1 *Reason.* If the gowned and gloved member of the team passes too close to an unsterile object, the sterility of the gown is uncertain. When the sterile sheet is being placed on the table, it may touch an unsterile object near it. The circulating members of the team must have a sufficient area in which to pass when they are near





Fig. 99.—Opening a large pack. The circulating nurse stands near the back of the pack, grasps the uppermost fold of the outer cover, and brings the fold over the front of the table or Mayo stand.

...fter the circulating nurse has turned back the ...ers of one hand under the turned-back corner ...ck of the stand or table. By keeping the fingers ... the circulating nurse is prevented from touching the underside of the wrapper and its contents

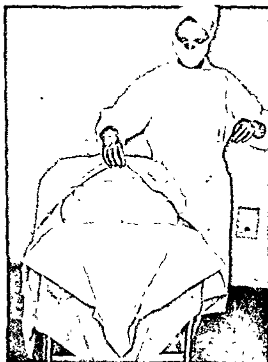


Fig. 101.—Opening a large pack—cont'd. The gowned and gloved nurse removes the pack, keeping the hands on the inner side of the muslin cover. (In this illustration the gowned and gloved nurse stands behind the back of the pack in order to show the gloved hands on the underside of the wrapper.)

Circulating Member—cont'd

toward the front of the stand. Removes the cord and places it in a designated receptacle. (Figs. 99 to 101.)

Reason—cont'd

a sterile object. The cord is kept clean by placing it in a receptacle.

2. Standing at either end of the pack, the worker grasps the uppermost fold near the top and brings the fold over the front of the stand. Places the fingers of one hand under the turned-back corner of the upper side, pulls it downward over the stand, then grasps the other side in the same way to free it. Steps back, extends arm, and grasps remaining fold, bringing it toward the back of the stand.

2. By placing the fingers beneath the turned-back corners of the wrapper, the worker is prevented from touching a sterile surface (inner side of the wrapper and contents). Correct body position minimizes the possibility of the worker coming in contact with a sterile surface.

Covering the Instrument Table With a Sterile Sheet

Aim: To provide a sterile surface on which to store sterile articles during the operation.

Suggested Steps:

1. *Scrubbed Nurse.* Faces the exposed sterile contents of the pack, extends the arms, and grasps the top folded sheet with both hands. Stands near the front of the table, keeping the arms extended and at a level with the lower chest. Places the fingers of each hand near the ends of the upper folds. Abducts the arms and rotates the hands inward so that the palms face upward, releases the folds, then places the lower portion of the sheet on the front area of the table and releases the folded ends over the table. Takes the contents of the pack from the inner side of the wrapper. Places the contents of the pack in the designated area on the sterile surface.

1. *Reason.* The gowned worker observes a wide margin of safety by touching only those articles which have been sterilized and are situated above the level of the table or waist of the gown. The worker holds the sterile sheet away from the body since only the front portion of the gown (from the area just above the waist to the level of the shoulders) is considered to be sterile. Holding the sheet at eye level or just below it facilitates handling. Extending the arms flexing the elbows, and then abducting the arms provides for economy of motion and safe handling. The portion of the sheet below the edges of the table must not be brought onto the surface of the table. The front edge of the table is covered first, in order to protect the sterile gown from the unsterile table. The articles have been packed in the order in which they will be used (Chapter 2).

Draping a Mayo (Portable) Stand

Aim: To provide a sterile surface on which to keep those sterile items used to perform certain steps of the operation.

Suggested Steps:

1. *Scrubbed Nurse.* Holds the slip-on cover in one hand, facing the free end of the stand, places the gloved hands beneath the uppermost fold at each side of the cover, extends the arms, slightly flexes the elbows, and slips the folded cover over the top of the stand. Places the foot nearest the stand on its base, inserts the gloved hands under the fold at the sides of the tray, brings the top end of the cover off the tray, then shakes the free portion of the cover, thereby forcing it to fall over the end of the tray (Figs. 102 and 103).

1. *Reason.* In the preparation, two thirds of the cover has been turned back on itself to prevent it from falling below the waist level of the gown. The uppermost fold provides a protective cuff under which the scrubbed worker can place the gloved hands.

Stabilizing the tray by placing the gloved hands at a level with the sides facilitates handling and permits free movement of the cover over the surfaces of the stand. A gowned and gloved worker never touches the lower portion of the cover which falls below the level of the sterile field.



Fig. 102—Draping a Mayo stand The muslin slip on cover is folded in such a way as to permit the gowned and gloved nurse to drape it over the Mayo stand with ease and to keep the uppermost surface of the cover sterile The folded cover is eased over the tray of the stand, then stabilizing the base with the foot, the gowned and gloved worker grasps the cover under its uppermost fold and brings the cover completely over the tray Due to photographic conditions the nurse's gown appears to be touching the sterile tray cover. In actual practice the sterile gown does not touch the stand or the sterile cover

Scrubbed Nurse—cont'd

2. Opens a small sheet on the top surface of the covered Mayo stand, then places two towels over the sheet. Folds under the free edges of the towels. Places a folded towel at each back corner (those which will be farthest away from the operative field). Places two skin towels at the center-back of the tray. Retractors will be kept on the folded towel nearest the nurse, and sutures will be kept in the folds of that towel. Solution basin for wetting gauze pads or sponges will be kept on second folded towel. The folded towel

2. The double-thickness foundation sheet and towel provide for a margin of safety between the Mayo stand (unsterile) and the uppermost surface of the towel (sterile field). The dry towel and sheet do not provide a true mechanical barrier from liquids containing bacteria. Fibers differ in their power to absorb, and linen absorbs liquids by capillary attraction.[48] If contaminated liquid is dropped onto the towel, it will penetrate the towel and contaminate the Mayo stand, and if sterile towels or instruments come in contact



Fig 103—Draping a Mayo stand The gowned and gloved nurse grasps the uppermost part of the cover on the tray and shakes the cover slightly, thus forcing the open end to fall below. Due to photographic conditions the nurse's gown appears to be touching the sterile tray cover. In actual practice the sterile gown does not touch the stand or sterile tray cover.

Scrubbed Nurse—cont'd

and sheet serve as a mechanical barrier against contamination for a considerable period when sterile solutions are dropped onto the sterile field.

Reason—cont'd

with the wet contaminated surface on the Mayo stand, the liquid in the towel would carry the bacteria upward onto the towel or instrument. When sterile solutions saturate the towel and sheet on the Mayo stand, allowing the liquid to contact the unsterile stand, the bacteria present are moistened and begin to multiply. However, it takes several hours for the bacteria to penetrate through the moistened sheeting, thereby contaminating the uppermost surface.



Fig 104—To fill the sterile arm basins with cold, sterile normal saline solution or sterile water, the circulating nurse does not allow the spout of a pitcher or neck of a flask to pass over the rim of the basin, or allow solution to drip from the outer surface of the container onto the sterile field If a pitcher is used the nurse does not touch the underfold of the towel and does not allow its center portion to fall over the sides. A pitcher is used only when sterile water is taken from a water sterilizer and a pitcher with a metal cover is not available.

Pouring Solutions Into Draped Ring-Stand Basins

Aim: To provide cold normal saline solution or water for the gowned and gloved members to use in removing tissue fluid and blood from their gloved hands (Fig. 104).

Suggested Steps:

1. *Scrubbed Nurse* Grasps a folded sheet with both hands. Stands in front of the stand, extends the arms, keeping the sheet at eye level

1. *Reason.* The sheet is held in front of and in the fingers of each hand for better control. Less energy is required when finger, wrist, and

Scrubbed Nurse—cont'd

and away from an unsterile object. Places the fingers of each hand under the uppermost fold near each end.' Abducts the arms and rotates them inward, thus bringing the uppermost surface of the sheet over the gloved hands. Unfolds the sheet, then places it over the stand. Takes the basin set from the inner surface of the opened wrapper. Places a large basin in each ring of the stand and arranges the remaining basins on the instrument table.

Reason—cont'd

symmetrical motions are used. Applying principles of work simplification saves the worker's time.

2. *Circulating Nurse.* Grasps the flask at the lower part of the neck; brings it near the sterile field. Removes the cap, pointing the inner surface downward. Pours off a small amount of solution into the waste receptacle. Holds the neck of the flask away from the sterile basin at a level of about 12 inches above it. Flexes the wrist, thus slanting the neck downward, allowing the solution to flow gently into the basin. Extends the wrist to stop the flow, places the cap on the flask, and returns it to the designated area.

2. Steadier control of the flask is obtained when it is grasped nearer the lower part, because the nearer the force is placed to the center of gravity, the less energy is used. Keeping the inner surface of the cap pointing downward protects it from contaminants. Pouring off a small amount of solution removes any organisms that may be present due to handling. The speed of flow of the solution depends upon the diameter of the neck and upon the pressure exerted.[48] The pressure exerted by a column of water varies with its height. Solution is not allowed to drip onto the outer surface of the flask (unsterile) as it may drop onto the sterile field.

Removing Sterile Items From a Jar With Transfer Forceps

Aim: To keep the item sterile while transferring it from one sterile area to another sterile area (Figs. 105 and 106).

Suggested Steps:

1. *Circulating Nurse.* Reads the label on the jar or container and removes the cover; holds it with the inner surface pointing down, or places it on a smooth, clean surface with the inner surface pointing upward. Grasps the handle of the transfer forceps, using the fingers (flexing the wrist), and withdraws the forceps from the solution in a vertical direction so that the jaws do not touch any

1. *Reason.* The inner surface (sterile) of the cover must be protected from air-borne organisms and other contaminants present on unsterile objects. Only the inner surface of the jar (which is in contact with the solution) is sterile. Keeping the forceps in a vertical position helps to provide a margin of safety. If the jaws of the forceps are turned upward, the solution (which adheres to the



Fig. 105.—The circulating nurse removes the sterile item from the container with transfer forceps and places the item in a sterile utensil on the sterile field, keeping the jaws of the forceps pointing down. The handle of the forceps does not pass over the sterile surface.



Fig 106.—To pour a solution from a bottle into a sterile utensil on a sterile field, the circulating nurse holds the stopper in the free hand She flexes the wrist of the other hand and keeps the arm and the bottle away from the sterile field

part of the inner rim or the outside of the jar. Holds the forceps with the jaws pointing down, introducing them into the jar in a vertical direction, and secures the item; removes it, making sure it does not touch the jar. Places it on the sterile area, passing only the jaws of the forceps over the sterile surface.

surface) will pass over the unsterile portion of the forceps, later contaminating the lower (sterile) part of the forceps.

Preparing Scalpels

Knife blades may be sterilized by immersion in a germicide, or packaged sterile blades may be purchased. To prevent contamination of the blade and injury to it and the worker, a beginning worker should learn a definite procedure for handling the blades.

Aim: To transport a sterile blade to a smooth sterile surface, and secure the blade to a scalpel handle without dulling the cutting edge of the blade.

Suggested Steps:

1. *Circulating Nurse.* Positions the jar, removes the cover, and grasps the transfer forceps, keeping the points turned downward. Grasps the blade from the blade rack without allowing it to contact the inner or outer surfaces of the container. Transports it to a sterile towel on the instrument table. Returns the transfer forceps and replaces the cover on the jar. Or, the worker grasps the flaps of the package containing the blade with the thumb and the first finger of each hand and pulls the flaps apart, thus exposing the sterile blade.

1. Blades are dulled by coming in contact with a hard surface or water or when exposed to the atmosphere for a considerable period of time.

2. *Scrubbed Nurse.* Allows the damp blades to dry by evaporation Grasps the scalpel handle in one hand, then grasps the blade, on the noncutting side and near the widest part, with a needle holder or the fingers. Slips the blade into the grooved lock on the handle. Places the scalpel on the Mayo stand, with the cutting edge away from other instruments. Places additional blades in fold of towel in suture basin.

2. To avoid cutting the hand, an instrument is used. Keeping the arms at a level with the lower chest and flexing the elbows conserves energy. Keeping the handle and blade at eye level provides for a safer performance.

RULES TO ENSURE ASEPTIC STANDARDS

The personnel should always follow the rules pertaining to "sterile" and "unsterile" surfaces. Such rules include the following:

All gowned and gloved members should observe a wide margin of safety when they are near unsterile objects, by using safe posture and good body mechanics, and by not coming in contact with the object.

When the sterility of an article is uncertain, it is considered to be unsterile. All members of the team must face a sterile object when they are near it.

When two gowned members pass each other, they must pass with their backs or their fronts opposite each other. Any article which falls below the waist level is considered contaminated.

The circulating members of the team must not reach over a sterile surface. When they are transferring articles to a sterile area, they must not allow the unsterile portion of the forceps to pass over the sterile surface. When they are removing a wrapper from a pack, they should keep their fingers under a protective cuff made of the wrapper.

When the circulating nurse removes a sterile sheet covering a sterile table, she brings the sheet toward her, keeping her hands under the protective cuff. When the circulating nurse moves a sterile apparatus or table, she grasps the legs of the table or lower portion of the apparatus at a level below the sterile area, and keeps her hands beneath all layers of the sterile cover.

PREPARING FLUIDS AND DRUGS

If a local anesthetic is to be used, the circulating and scrubbed nurses check the label on the flask. The scrubbed nurse fills the syringes with the solution, attaches the needles, and places the syringes and additional needles on the Mayo stand. Before handing the solution to the operator, she tells him the name of the drug and the dosage. After the skin has been infiltrated, the nurse removes the contaminated needle without touching the shank, places it in the basin, and attaches another needle to be used for infiltrating the deeper tissues in the wound The circulating nurse records the name of the drug and the dosage on the operating room sheet and on the patient's chart.[45]

During the operation normal saline solution is needed to moisten the gauze sponges. It should be kept at about body temperature. Studies indicate that hot applications of moist gauze compresses are not only inefficient in controlling diffusely bleeding surfaces, but may be dangerous as well.[49]

During the preliminary preparation of the unit for the patient, the circulating nurse should be sure the following articles are available: an emergency drug tray, intravenous infusion set, a transfusion set, intravenous solutions, a phlebotomy set, a stopcock, a wooden arm splint, an armrest or foot cradle, adhesive strips, and a tourniquet. Sterile cannulas and needles of assorted sizes and sterile pieces of intravenous tubing (each about 18 inches long) should also be available in the unit.[50-52]

To administer fluid or blood through a cannula, the circulating nurse opens the sterile phlebotomy set on a small stand. If the cannula is inserted in a vein

in the patient's ankle, the ends of a free piece of intravenous tubing are attached to the lower end of the intravenous tubing of the set and the needle or cannula. The additional tubing allows the set to fall free of the sterile sheets and permits the flask to be elevated. Usually the ankle and needle are protected by a small cradle.[51-54]

When a combination of spinal, inhalation, and intravenous anesthesia is employed, the graduate circulating nurse should be ready to give additional care to the patient under the supervision of the anesthesiologist.[50-52]

Before the patient arrives, the circulating nurse should check the emergency drug tray which usually includes a sterile knife wrapped in silver foil, a sterile New York Hospital rib separator (Chapter 9), a jar of cotton balls, several sterile syringes and needles of appropriate sizes, ampules of drugs for cardiac resuscitation, a tourniquet, and a germicide. A sterile emergency setup for opening the chest cavity and other apparatuses used in treating cardiac failure should be available.

When a narcotic is ordered for the patient, the circulating nurse should notify the head nurse, who will obtain the drug and narcotic sheet from the locked medicine cupboard. The circulating nurse reads the label on the bottle and prepares and administers the drug to the patient. She records the time, drug, and dosage given, as well as her own name, on the patient's chart and on the narcotic sheet.[39,45]

Whole blood is obtained from the blood bank by a physician. In surgery, two professional workers check the label on each bottle of blood and the blood grouping recorded on the patient's chart. Blood is usually administered by means of a tandem after an infusion of normal saline solution has been injected.[55]

CARE AND HANDLING OF GAUZE SPONGES

The graduate operating room nurses, with the assistance of the central service supervisor, are responsible for instituting a method for packaging, handling, counting, and recording the number of gauze sponges and pads used in surgery. The system should be approved by the surgical committee. A description of the procedure should be included in the procedure manual.

Types of Sponges.—The types of sponges and number of different sizes used in surgery should be kept to a minimum. Several sizes of flat gauze sponges, with and without a detectable x-ray element, are needed. They should be packaged in bundles of 8, 16, and 24. A few sizes may be prepared in bags (24 or 48 sponges per bag). The use of a muslin bag provides for safe and easy handling during the operation. Several sizes of laparotomy pads with an x-ray element enclosed are needed. A metal ring is secured to the loop of tape attached to each of the pads which are grouped in bundles of 6 or 8, the pads counted and then packaged for sterilization.

Procedures for Counting Sponges.—Various methods of keeping a sponge count are in use.[25,41,43] In some operating rooms a sponge count is not taken, but all free sponges are removed from the field when a cavity is opened. From then on until the wound is closed, all free sponges are secured to sponge-holding

forceps. The operators return each sponge on the forceps to the gowned and gloved nurse. A metal ring is secured in the loop of the cotton tape attached to each pad used in a deep cavity. In most hospitals an accurate count is kept of all tape pads placed on the sterile table; and in many hospitals a count is also kept of free gauze sponges used in deep wounds or in other wounds in which a sponge could be accidentally left in the patient. A sponge count should be taken in such operations as laparotomy, celiotomy, a thoracic procedure, an open operation on the hip or shoulder, a radical mastectomy, and a major vaginal operation.

Handling Sponges.—During the preliminary preparation, the nursing members of the operating team count the sponges when they open each pack. The circulating nurse records the count on a special form. If the pack does not contain the prescribed number, it is returned to the central service and another pack is opened.

To count small sponges, the gowned and gloved nurse opens a towel over the sterile table, empties the sponges onto the towel, and counts them as she returns them to the original bag. To count sponges packaged in bundles, the nurse shakes the bundle to separate the sponges. Holding the bundle in one hand, she counts the sponges as she places them in a designated area on the sterile table. The gauze sponges are kept together according to size, and all sponges are kept away from towels or sheets to eliminate the danger of a sponge being carried in the towel into the wound.

A piece of paper wrapping is placed in a designated area on the operation room floor for the storage of soiled sponges. The circulating nurse stacks them in groups according to kind and number contained in the original package.

The gowned and gloved nurse places a basin on the sterile field so that the operators can discard the soiled sponges in it. To discard the soiled sponges into the towel resting over a kick-bucket, the gowned and gloved nurse touches only the outer surfaces of the basin, keeps it at the level of her waist, and turns in such a way that the back of her gown does not touch the sterile field. The circulating nurse removes the sponges from the bucket, using forceps, or removes the sponges in the towel, after which she re-covers the bucket. This method eliminates the need for the gowned and gloved workers to discard each sponge into a bucket, decreases the handling of soiled sponges, and keeps them off the floor.

Large and small gauze sponges are never placed in the solution basin together, since a smaller sponge may be carried into the wound with the larger one. When handing specimens to the circulating nurse, towels should be used instead of gauze sponges When a ringed-tape pad is used in the wound, the ring must remain on the sterile field and not be allowed to hang below.

Before the wound is closed, the circulating nurse counts the discarded sponges, and the gowned and gloved nurse counts all sponges on the sterile instrument table and also those stored in the solution basin. The circulating nurse totals the count (those on the sterile table and those discarded), subtracts this figure from the total number recorded on the form. She then reports to the as-

sistant operator the number of sponges needed to complete the count. The operators count the number of pads and sponges in the wound, and the circulating nurse advises them if the total count is correct or incorrect. If this third count is incorrect, the entire count is repeated. If a sponge cannot be found, an x-ray picture may be taken to determine if the sponge is in the patient. Such incidents are usually recorded in the operation record book even if the sponge is found. In some hospitals a fourth count is taken after the wound is completely closed.

PREPARING RADIUM FOR USE IN PATIENTS

Radium is used in the treatment of suspected or cancerous lesions. The forms of radium include radon seeds or implants, radium needles, and radium in tubes, applicators, plaques or bombs.[21,27]

Radium is sterilized by immersion in a suitable germicide in a container which has thick lead walls to stop the rays. Radium remains in this container until it is ready to be inserted in the patient.

To prepare radon seeds, the gowned and gloved nurse places a small sheet over a table upon which to place the radon seeds and needles. She removes the radon seeds or radium from the sterilizing container with forceps. To prepare radon seeds, she withdraws the stylet in the applicator about one-half inch, inserts the seed, and passes the point of the applicator through petrolatum. She hands the applicator to the surgeon, who inserts the needle into the tissues and pushes the stylet into the applicator, thus forcing the seed into the tissues (Chapter 15).

Radium needles, which are hollow sheaths of metal, contain one or more cells of radium. The needles may be 11 to 60 mm. in length, depending upon the area involved and the dosage.

To thread the radium needle, the nurse takes a 20-inch piece of silk, size 2, threads it through the eye, using a wire needle threader and a long-handled grooved forceps to stabilize the needle. She ties a square knot just below the eye, leaving the ends of the suture free and even. After the surgeon has inserted the needle, he anchors it with a suture (Chapter 15). The free ends of the suture are fastened to the skin with cellophane or adhesive tape.

Precautionary Measures.—The surgeon who uses radium is responsible for its safe handling The person who is responsible for the control and use of radium in the hospital dispenses it. He also must be notified when the radium has been *removed from the patient.* When radium is dispensed, specific data are recorded in the book designated for this purpose. The following information is recorded. date, hour, amount of radium taken, type of applicator, surgeon's name, patient's name and his hospital number or room, and signature of person who takes it. When the radium is returned to storage, the person who is responsible for it checks the amount, returns it to the storage compartment, and records the date, the hour, and the amount.

Measures must be taken to prevent the loss of radium, as it is expensive, and, more important, lost radium can produce serious reactions and burns in persons who come in contact with it. When radium is lost, items are not removed

from the room, and the radium technician is notified immediately to locate it with a Geiger counter.

Workers should never handle radium containers, such as needles or tubes, with a crushing instrument, since it may break the container. A grooved-tip forceps should be used.

Two professional workers count the needles, tubes, or cells when they receive them; and the surgeon usually puts the cells in tubes, unless it is done by the radiologist. Radium must not be sterilized by any form of heat, and must be kept in a metal container constructed of heavy lead.

Film badges are worn by workers in the radium laboratory and by persons caring for the patient who has radium.[30,56-58]

A radium therapy sheet is attached to the patient's chart and a special tag is attached to the patient's bed, signifying the time of application and the time for removal (Chapter 2). The surgeon who cares for the patient makes sure that *the correct instructions and the time to remove the radium are written in the* doctor's order book. The precautionary rules, as adopted by the hospital, must be observed by the workers as they care for patients who have been given radioactive materials.

Cobalt 60, in the form of irradiated wire, is used in small lengths and stored in steel needles which are used in the same way as radium.

HANDLING SPECIMENS

The nursing staff should follow the procedure written in the hospital manual for the handling of specimens. A specimen of tissue is not discarded without the surgeon's permission. To prevent small specimens from being lost or damaged, the specimen container should be sterilized and kept on the instrument table. The bottle containing the specimen is handed to the circulating nurse who labels it and fills in the laboratory forms. All specimens, such as blood or sputum collected for diagnostic tests and sent to the laboratory, are recorded on the patient's chart.

ADMISSION OF THE PATIENT TO THE OPERATING ROOM

The circulating member of the team is ready to care for the patient when he arrives in the operating room. The worker accepts the patient (conscious or unconscious) as a person with a body of a complex design and function.[5,47] If the patient is awake, she greets him by name and introduces herself and other allied professional members of the team She tries to gain his confidence by short explanations and through her own warmth and acceptance of his personal fears and his physical needs at this time. She may reassure a member of the patient's family by her own attitude and explanations of the procedures to be performed.

The nurse is alert to recognize the differences in patients and tries to accept her role in each instance. For example, she gives the child a toy if he does not have one with him. She listens to what the patient is trying to tell her,

and she encourages those whose needs and fears are usually exaggerated by their physical condition.

She tells the surgeon that the patient has arrived and gives him an opportunity to talk to the patient.

She makes sure his religious medals or wedding band are securely fastened in place and that they are returned to the nursing unit with the patient.

To protect the patient from accidental harm, the worker applies supports and restraints and remains with him. She checks his name on the listing of operations and checks the reports on the chart as adopted by the department. Such activities include checking the permit of operation, the proposed operative site, and the removal of all jewelry, chewing gum, false teeth, and hair pins. She loosens the fasteners from his gown and covers him with a cotton sheet.

She endeavors to provide a quiet, comfortable environment and a pleasant atmosphere for the patient. She makes sure the temperature of the unit is suitable. (Chapter 2.) In a very warm environment, the person's heart beats more rapidly and more blood is brought to the surfaces to be cooled. A warm environment (above 85°F.) may cause a rise in the patient's temperature, depending upon his age and physical condition. An increased body temperature decreases the patient's ability to survive hemorrhage or shock.[35,49]

The circulating nurse accompanies the patient to the operating room unit, locks the brakes of the table and bed, and helps transfer the patient from the bed to the operating table.[23,52,59,60]

POSTURE OF THE PATIENT ON THE OPERATING TABLE

There is no one method for positioning the patient on the operating table for a particular type of operation. Suggested step-by-step descriptions of positions for various operations, as presented in the following chapters, aim to serve as helpful guides to the operating room nursing staff and other professional workers as they evaluate procedures for positioning patients for surgery. Class demonstrations and instructions which focus on the principles of body posture for patients and the reasons why complications due to malposition may occur should help the inexperienced worker to carry out the proper procedure more readily.

The surgeon, the anesthesiologist, and the graduate nurse, in accepting their responsibilities for proper body posture of the patient, carry out activities which help to maintain physiologic functioning, to reduce or eliminate accidental injury and discomfort, and to maintain the dignity of the patient as a person.

Safe posture of each patient on the operating table is influenced by: (1) the type of operation to be performed; (2) the type of anesthesia and supportive measures to be administered; (3) the age, height, and weight of the patient; (4) the patient's general physical condition and the presence of anomalies, and (5) the devices available to support and maintain good body alignment.

The nurse should have a general understanding of factors which cause postoperative complications due to malposition and the effects of anesthesia and posture on the normal physiologic functions in patients.

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pooling of blood.[69, 72] When the factors fail (those which normally aid the venous return in raising the blood against gravity), accumulation of blood in the dependent parts (legs and arms) usually occurs. Due to an exaggerated and abnormal position, and/or the injection of certain drugs, the intermittent contractions of the skeletal muscle fibers may be decreased, thus diminishing the action of the veins in propelling the blood in the upward direction (Chapters 9 and 10). *Severe pressure by acute angulation of the body (jackknife, kidney, and prone with legs elevated) may produce stagnation of the blood in the splanchnic area.*

Fig. 107.



Fig. 108.

Fig 107.—A steep Trendelenburg position as shown may reduce the vital capacity of the patient (From Slocum, H. C, Hoeflich, E A., and Allen, C. R: Surg Gynec & Obst. *84:1051*, 1947)

Fig 108.—A kidney, lateral, or jackknife position may cause circulatory and respiratory embarrassment, and muscle strain. (*From Slocum, H C, Hoeflich, E A, and Allen, C. R.:* Surg. Gynec. & Obst 84:1051, 1947)

Effects of Anesthesia.—When the patient has been anesthetized, his perceptive powers no longer function. He is unable to complain of physical discomfort which normally would not be tolerated. Because muscle tonus is reduced by administering an anesthetic, the patient is more susceptible to effects of abnormal physiologic positions. Damage to the nerves may occur but may not be discovered until the patient is awake.[61,62]

The use of an anesthetic may increase the danger of nerve injuries. When the patient is in an exaggerated Trendelenburg position, even when the shoulder braces are correctly applied, reduced muscle tonus of the shoulder girdle helps to compress the brachial nerve plexus between the clavicle and the first rib, thereby causing nerve injury (Fig. 109). Studies show that patients who had a general anesthetic suffered from paresis of one or more nerves, but those patients who had spinal anesthesia and were able to complain had no nerve damage.[61, 73 76]

When the patient is deeply anesthetized, his breathing is done by the diaphram, since the intercostal part of respiration tends to be abolished. Excursion of the diaphragm during the expiratory phase is impaired due to the loss of abdominal muscle tone. There are, however, other factors which effect respiratory embarrassment, such as raising the kidney rest and position of retractors and laparotomy pads in the wound.

Effects of Posture on Respiratory Functions.—*The patient can best tolerate* the supine-horizontal position. Other positions (lithotomy, Trendelenburg, kidney, lateral, side-lying, prone, or jackknife) may reduce the vital capacity of the patient (Chapter 9). Studies indicate the effects of different positions upon respiratory function.[62 69] If the patient has a low vital capacity due to systemic disease and is placed in a position which further reduces the respiratory volume, serious complications may arise.[64] Changing the position of the patient on the table effects the tidal volume of the anesthetized patient so that a change in the volume of residual air may occur. This is one reason changes in position should be made slowly and deliberately.

When the patient is placed in a lateral or prone position so that he is resting on the lower ribs, respiratory embarrassment may occur.[67] The vital signs may include rapid, shallow breathing or secondary circulatory changes.[65] Good body alignment is necessary to help provide for a free airway so that oxygen is supplied and carbon dioxide is eliminated. The volume of air in the lung may be decreased by placing the patient in the supine position with his head down or in the lateral position with or without the kidney rest. Studies show that vital signs in healthy unsedated adults change when their positions are shifted from a supine to a lateral, lithotomy, or Trendelenburg position.[62,69]

To provide adequate ventilation of gases through and out of the lungs, it is necessary to provide for freedom of movement of the ribs and the diaphragm, a freely expandable chest wall, proper functioning of the neuromuscular structures, and nonobstructed air passages (Figs. 107 and 108).

Effects of Posture on Circulatory Functions.—Circulatory embarrassment begins by venous and capillary stasis in dependent extremities or by splanchnic

Factors which cause respiratory impairment are extreme flexion of the body, pressure against the ribs by the kidney elevator or braces, inward rotation of the arm, lateral flexion of the neck, and internal rotation and adduction of the femur. Lithotomy position, with extreme flexion of the thighs, plus Trendelenburg position should also be avoided, since respiratory functions are impaired due to increased intra-abdominal pressure. When the patient is kept in a flat, prone position (face-down) on the operating table, the existing intra-abdominal pressure interferes with diaphragmatic action.

Effects of Posture on Nerves.—Due to the anatomic relations of the brachial plexus and its surrounding structures, injury to the plexus from malposition may occur (Fig. 110). Studies show that most injuries are preventable. The principal reason for nerve injuries is ischemia, due to stretching of and pressure on the nerves. Pressure for even a few minutes may cause impaired nerve function. Tension on the nerves is due to increasing the distance between two points of fixation.[61,74-76]

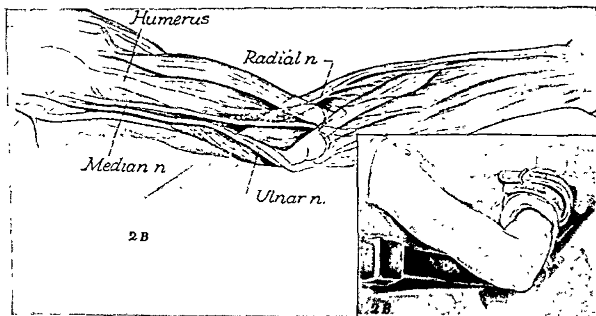


Fig 110—Drawing showing points of danger to nerves of the arm resulting from pressure. As shown in the inset, pressure may be exerted against inner arm when a patient is improperly positioned on the operating table. (From Slocum, H C, O'Neal, K. C, and Allen, C. R: Surg. Gynec. & Obst. 86:729, 1948)

Reports of studies indicate that injury of the brachial plexus may result from one or several of the following factors:

1. Stretching the nerves over the arch formed by the tendinous attachment to the pectoralis minor and the coracoid process, and depression of the clavicle into the retroclavicular space.

2. Stretching the plexus over the prominence formed by the head of the humerus with the extended arm externally rotated and abducted more than 85 degrees. Abduction of the arm at a 90-degree angle and external rotation of the arm cause the clavicle to move dorsally. This situation reduces the distance between the clavicle and the first rib, which in turn displaces the plexus laterally. (Fig. 109.)

Dependent positions of the legs, arms, and head tend to reduce the venous return to the heart. (Figs. 107 and 108)

When the patient is placed in a head-low position (reverse Trendelenburg), intra-abdominal pressure may occur due to the ventral compression of the abdomen and to the weight of the viscera. This posture affects normal respiratory exchange and the pumping action of the diaphragm which normally aids in venous return. Using an extreme reverse Trendelenburg position, venous and cerebrospinal fluid pressures are also increased, thus interfering with the inflow of the arterial blood. With the patient in the lateral position, venous return to the heart from all the extremities tends to be retarded by gravity (Figs. 112 and 113).

Peripheral vascular damage may occur when the arm is hyperabducted more than 80 degrees, due to compression or occlusion of the subclavian or axillary arteries (Fig. 109). Venous thrombosis may result from stasis when braces, stirrups, pads, or straps occlude the superficial veins (Fig. 111).[70-75]

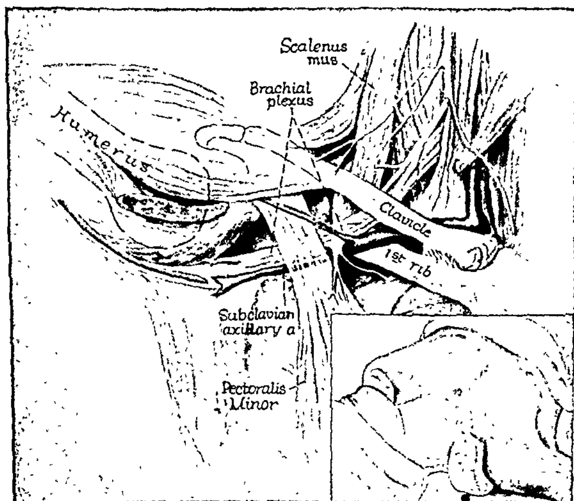


Fig 109—Anatomic relations of the brachial plexus, with the arm in hyperabduction simulating relations of soft structures in the "hyperabduction syndrome" Inset the patient is shown in a Trendelenburg position. The shoulder brace as shown is misplaced due to the extension of the arm on the armrest (From Slocum, H C, O'Neal, K C, and Allen, C R.: Surg. Gynec. & Obst 86:729, 1948)

This situation may result in wrist-drop, weakness of the arm, and sensory changes due to radial nerve paralysis.

9. With lateral flexion of the patient's head to the opposite side and with accompanying overstretching of the brachial plexus.

Injuries to the peroneal nerve, lumbosacral spine, popliteal nerve, and the eye are also due to tension and pressure (Fig. 111). In lithotomy position con-

Fig. 112.

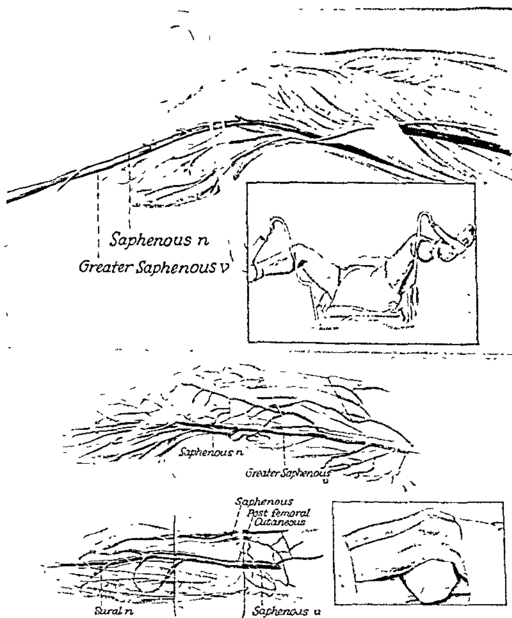


Fig 113.

Fig 112.—Diagram of structures vulnerable to pressure from leg braces With the patient in a lithotomy position, the inset shows the braces pressing against the legs (From Slocum, H C O'Neal, K. C, and Allen, C. R. Surg Gynec & Obst 86:729, 1948)

Fig 113.—Diagram of structures subject to injury in the pressure areas illustrated in inset, which shows compression of the legs between a hard knee roll and tight strap. (From Slocum, H C., O'Neal, K. C, and Allen, C. R. Surg. Gynec & Obst 86:729, 1948)

3. With the patient in the lateral position, elevation of the uppermost part of the arm over the patient's head and extension of the forearm to the other side of the body.

4. With the patient in exaggerated Trendelenburg position (more than 30-degree flexion), the arm hyperextended on an armrest, and inadequate shoulder braces placed incorrectly (Fig. 109). In this position the patient may be suspended by the wrist, thereby stretching the plexus downward over the first rib.

5. With the patient's arm extended from the side on the armrest and his body resting against the shoulder braces primarily. When this occurs, the arm acts as a lever and moves the patient to that side of the table. The brace no longer presses against the bony acromioclavicular portion of the shoulder, but presses against the trapezius muscle and the brachial plexus (Fig. 109).

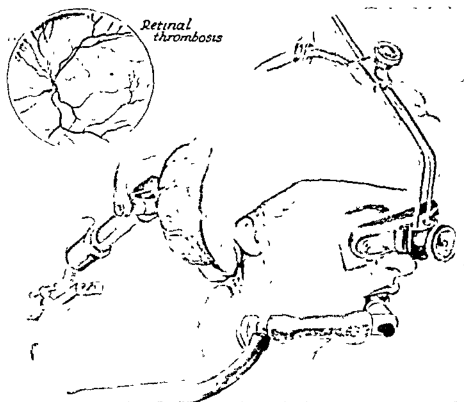


Fig. 111.—Pressure on the eye, resulting from improper position of the headrest during a neurosurgical procedure for resection of the fifth nerve. The Bailey headrest, was used; the head pushed to one side, forehead piece slipped, causing pressure on the eye. (From Slocum, H. C., O'Neal, K. C., and Allen, C. R. Surg Gynec & Obst 86:729, 1948.)

6. Presence of congenital anomalies such as cervical ribs.

7. Compression of the ulnar, median, or radial nerves, as they transverse the brachium, due to pressing against the edge of the operating table; or allowing the arm to hang over the edge of the operating table, which may cause the nerve to become compressed between the humerus and the table.

8. With the arm hyperextended on an armrest, and the anterior aspect of the arm forced against the anesthetist's screen, attached to the edge of the table.

Fig 115—Conventional stirrups rotated and raised, reducing the abduction and extending of the legs, and tracing of the lateral x-ray in this position. (From Hunter, R. G., Henry, G. W., and Larsen, I. J: Obst. & Gynec. 4:344, 1954)

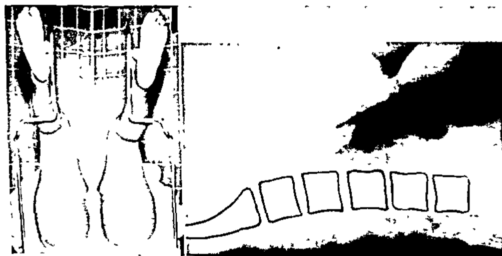


Fig. 116.—With the patient in a lithotomy position, using the revised stirrups, and showing tracing of the lateral x-ray of the position. (From Hunter, R G, Henry, G. W., and Larsen, I. J. Obst. & Gynec. 4:344, 1954.)

tinual pressure on the lateral aspects of the patient's knee, caused by the weight of the leg itself, may cause injury to the peroneal nerve. Pressure beneath the popliteal space, due to the presence of a large, hard pad, or due to flexion of the knee at more than 5 degrees, may result in nerve injury (Figs. 112 and 113).

With the patient in lithotomy position, extensive arching of the lumbosacral spine, which causes backache, is due to abduction and outward rotation of the legs as they are held in the stirrups (Chapter 15).

Effects of Posture on Muscles, Tendons, and Bones.—With the patient in sitting position, if the feet remain in dorsiflexion while the trunk is flexed forward, hyperextension of the knees may result. A footpiece attached to the end of the table at a correct angle prevents this condition.

When the neck and head are not in good body alignment and properly supported, the muscles of the neck contract. The bony prominences (elbow, coccyx, and ankle) press against the tissues and nerves if the body is not supported by a firm mattress and the extremities by suitable sponge-rubber pads.[61,75,76]

To prevent inward rotation of the arm and extension of the elbow, the arm should be placed along the side of the body, with the forearm pronated slightly, the elbows flexed slightly, and the fingers straight but not extended. The arms should be enveloped in the flaps of the lift sheet to stabilize them.



Fig 114.—Conventional lithotomy position, with conventional stirrups, and tracing of a lateral x-ray of the lumbosacral spine of the patient in this position. (From Hunter, R. G., Henry, G W, and Larsen, I J Obst & Gynec. 4 344, 1954)

With the patient in lithotomy position, Hunter[75] reports a method to relieve the frequency of postoperative backache following the use of stirrups. In this study the x-ray findings of the lumbosacral spine of patients in lithotomy position show arching is produced by the pull on the adductors (which are attached to the pubic rami) and by the stretch of the iliopsoas muscle which is attached to the lesser trochanteric area of the femur (Chapter 17) These muscle pulls rotate the pelvis, thus causing an abnormal arching of the back (Fig. 114). The table becomes a fulcrum when the buttocks are drawn beyond the edge.

The study also indicates that knee crutches carry some of the weight of the legs, reducing some strain on the hip joint capsule, but crutches do not eliminate outward rotation and abduction which increase arching of the lumbosacral spine (Figs. 115 to 116).

Circulating Nurse—cont'd	*Reason—cont'd*
patient is a woman, padded shoulder braces are assembled.	energy. A Trendelenburg position may be used and braces should be applied before the patient is covered with sterile sheets.
4. Covers the patient with a clean cotton sheet. Locks the brakes on the table and bed. Uses a bed roller if necessary. Assists patient onto the operating table. Sees that area of skin is touching exposed mattress.	4. The patient must not suffer from personal embarrassment. Woolen and synthetic textiles are insulators, and once electrified they may possess high electric charge. Airborne bacteria on patients' bedding should not be dispersed in the unit. Safety measures are carried out to prevent personal accidental injury.
5. Makes sure the base of the patient's neck is over the break of the table and the head is straight with the spine. The head and neck are supported by a thin pillow. The back is resting on the table, the hips are parallel, and the knees are at the lower break of the table. Places a small, thin pad under the lumbosacral spine if necessary and if not contraindicated.	5. Lateral flexion of the neck causes contracture of muscles and pressure on the brachial plexus. The chest should be allowed to come forward. The shoulders are abducted and flexed slightly forward to maintain adequate respiratory functioning. The bony prominences of the back press against the spinal nerves. Arching of the back also produces strain on the nerves and muscles.
6 Attaches the armrest at same level with the table and not exceeding an 80 degree angle. Makes sure the armrest is long enough for the patient's extended arm and hand. Adds an extension piece and padding if necessary.	6. If the arm is abducted to 90 degrees and externally rotated, the clavicle is moved dorsally. The distance between the clavicle and first rib is reduced and the brachial plexus displaced laterally. The armrest must be wide enough so that the arm will not protrude and press against the anesthetist's screen.
7. Extends the affected arm on the armrest, flexes the elbow slightly, places the hand with palm downward, fingers slightly flexed, and thumb slightly abducted. Secures wrist and upper arm to armrest by applying restraints, and fastens them under the armrest on the side nearest the head of the table Places fingers under restraints to make sure they are not too tight.	7 Flexing the elbow relieves tension on the ulnar, radial, and medial nerves and on the muscles. Separating the fingers slightly provides for peripheral circulation, and placing the arm and hand properly on the armrest prevents pressure on the ulnar nerve and prevents wrist drop A light restraint provides for safety without causing impairment.
8. Places the other arm on the lift sheet Slightly flexes the elbow, places the arm parallel with the body, separates the fingers, and places the wrist flat and palms down on table. Then secures the forearm in the flaps of the sheet.	8 Provides for proper muscle balance. Relieves strain on muscles and nerves.

Developing Procedures for Positioning the Patient for Surgery.—The members of the operating room team apply their knowledge of anatomy and physiology when placing the patient in a particular position so that strain and pressure on normal body functioning is alleviated. The patient's position is altered until the surgeon, anesthesiologist, and nurse are satisfied that the patient is adequately protected.

During demonstrations the instructor emphasizes the principles of good body alignment. For example, she will explain the purpose and use of the available devices for maintaining adequate safety, comfort, and good body alignment.

For general use, the items needed are as follows: a modern operating table of sufficient length, a mattress made of thick foam rubber, encased in a zipper-type rubber cover which is explosion-proof (foam rubber retains a uniform firmness and reduces body pressure against the bony prominences); table attachments including a metal foot piece and foam-rubber pad, two well-padded kidney braces, and two shoulder braces with adequate foam-rubber pads which fit neatly and securely onto them; an anesthetist's screen and two stirrups designed to prevent external rotation of the thighs and pressure on the legs.

Other supports should include foam-rubber pillow for head and shoulders, small, thin foam-rubber supports for lumbosacral region, knees, and ankles, and large pillows to elevate the chest region and support the legs. A bed roller aids the workers in lifting patients from one vehicle to another.

Supine Position With Arm Extended on Armrest.—There is a common core of action in positioning patients for surgery. For example, the instructor may present the procedure for supine positioning as follows:

Suggested Steps:

1. *Circulating Nurse.* Makes sure the length of the table is suitable to the height of the patient, and that the mattress will protect the bony prominences. Attaches the padded foot piece, if needed	1. *Reason.* When legs and feet extend over a table, undue strain is exerted on the nerves and muscles. The sharp edge of the table may also cause impaired neuromuscular functions by direct pressure against the segments of the spinal nerves and by pressure on the great saphenous vein or dorsal venous arch.
2. Covers the table pad with a cotton sheet, places a "lift" sheet across the table, a small pillow at the head, if desired, and a small, thin pad of foam rubber over the foot break of the table. Leaves lower part of mattress exposed	2. To protect the patient from explosion hazards, the safety measures recommended by the National Fire Protection Association should be followed (Chapter 2).
3. Assembles the padded armrest of sufficient length and width, and the anesthetist's screen. If a celiotomy is to be performed and the	3. If possible, all pieces of equipment should be assembled on the table before the patient arrives, thus conserving time and human

27. Ochsner, A., and others. In Christopher's Minor Surgery, ed. 7, Philadelphia, 1955, W. B. Saunders Co., chaps 1-4.
28. Coten, L., and Maret, R.: Importance of Skin Towels in Orthopedic Operations, A. M. A. Arch. Surg. 69:510, 1954.
29. Prickett, Edna: Work Simplification in Central Supply Service, Hosp. Topics 31:75, July, 1953.
30. Zimmerman, L. M., and others: Physiologic Principles of Surgery, Philadelphia, 1957, W. B. Saunders Co.
31. Sister Mary Leon: H. R. Lithotomy Sheet, Am. J. Nursing 54:991, Aug., 1954.
32. Volpe, B.: Radical Head and Neck Surgery Nursing Functions, Hosp. Topics 32:73, Sept., 1954.
33. Walters, C. W.: The Aseptic Treatment of Wounds, New York, 1948, The Macmillan Co.
34. Farnworth, Mary: Roller and Triangular Bandaging, ed. 3, London, 1956, Faber & Faber, Ltd.
35. Clark, R. E., Orkin, L. R., and Rovenstine, E. A.: Body Temperature Studies in Anesthetized Man, J. A. M. A. 154:311, 1954; Hosp. Topics 33:74, 1955
36. Ross, Francis F.: What Can We Teach the Student Nurse in the Operating Room? Hosp. Topics 33:84, June, 1955
37. Fuerst, E., and Wolff, La Verne: Teaching Fundamentals of Nursing, Philadelphia, 1956, J. B. Lippincott Co.
38. Terenzio, J: Some Legal Aspects of Evening and Night Nursing Supervision, Nursing Outlook 4:606, Nov., 1956.
39. Terenzio, J: The Operating Room Nurse and the Law, Hospitals 30:16, Nov., 1956.
40. Barbee, Grace C: When Is the Nurse Held Liable, Am J. Nursing 54:1343, Nov., 1954.
41. Hall, Edith: Sponge Count, Hosp. Topics 31:73, July, 1953.
42. Nicholson, J J, and Orr, R. B.: Fire and Explosion Hazards in the Operating Room, S. Clin. North America 6:783, 1956.
43. Editorial: Sponge Count, Hospitals 30:35, July, 1956.
44. Hayt, E: A Signed Permit for Surgeons Is Safest (Part I), Hospitals 24:56, June, 1950
45. Lesnik, M. J, and Anderson, B E: Legal Aspects of Nursing, Philadelphia, 1955, J. B Lippincott Co
46. Hampton, O. P: Fundamentals of Surgery in Contaminated and Infected Wounds, J A M. A. 154:1326, 1954
47. Bird, B: Psychological Aspects of Pre- and Post-Operative Care, Am. J. Nursing 55 635, Feb., 1955.
48. Stearns, H O: Elementary Medical Physics, New York, 1947, The Macmillan Co.
49. Vallee, L., and others The Influence of Temperature on Surface Bleeding, Favorable Effects of Local Hypothermia, Ann. Surg 143:660, 1956
50. Eversole, Urban: A Method of Anesthesia for Upper Abdominal Surgery, S Clin North America 6:653, 1956
51. Elkinton, J R, and Donowski, T S The Body Fluids, Baltimore, 1955, Williams & Wilkins Co
52. Patrick, R T., Ridley, W R, and Pender, J: Anesthesia and Supportive Therapy for Patients Undergoing Cardiac Surgery, S Clin North America 8:911, 1955.
53. Talbot, N. B, Crawford, J B, and Butler, A. M: Homeostasis Limits to Safe Parenteral Fluid Therapy, New England J Med 248:1100, 1953
54. Baffles, T G: Fluid Electrolyte Therapy in the Surgery of Infants and Small Children, S Clin North America 12:1453, 1956
55. Howland, W S, Schweizer, O, Boyan, C P, and Dotto, A C: Physiological Alternations With Massive Blood Replacement, Surg Gynec. & Obst 101:479, 1955
56. Low-Beer, B V: Organizing and Controlling the Use and Safe Handling of Isotopes, Hospitals 29:51, 156, Dec., 1955.
57. Quimby, Edith H: The Use of Radioactive Isotopes as an Adjunct to Surgery, S Clin North America, New York Number 4:345, 1956
58. Quimby, Edith H.: Safety in Use of Radioisotopes, Am J Nursing 52:240, April, 1952.

Circulating Nurse—cont'd

9. Makes sure the legs are straight and parallel (about three inches apart) and at right angles. Places a *small, thin pad beneath the* knees, and a pad at the back of each ankle. Attaches the knee straps over the lower portion of the knees, if required, and checks to see if it is loose enough.

Reason—cont'd

9. Knees are flexed slightly to relieve pressure on the popliteal nerve and on the muscles and *nerves of the mid-calf. The pad* should fit the space beneath the knee properly to prevent pressure. A leg strap should be used only as a safety measure.

REFERENCES

1. Beatty, M. M: Training for Leadership, Nursing Outlook 4:504, Sept., 1956.
2. Goldthwait, J E.: Essentials of Body Mechanics, ed. 5, Philadelphia, 1952, J. B. Lippincott Co.
3. Perrodin, C A: Supervision of Nursing Service Personnel, New York, 1954, The Macmillan Co
4. Prickett, Edna: The Operating Room Supervisor at Work, New York, 1955, Department of Hospital Nursing, National League for Nursing.
5. Alexander, E. L.: Patient-Centered Care, Hosp Topics 33:75, Dec., 1955
6. Arnold, Harriet: No Admittance to the Operating Room, Nursing Outlook 4:678, Dec., 1956.
7. Byrd, B. M.: Orientation of Graduate and Student to the Operating Room, Operating Room Supervisor & Nurse 6:6, June, 1951.
8. Fuerst, V.: An Approach to Teaching the First Course in Nursing, Am. J. Nursing 54:466, April, 1954
9. Garrison, J P. Development and Function of the Surgical Committee, Hosp. Topics 33:68, April, 1955.
10. Kuehn, R P There's Method in These Nursing Studies, Mod. Hosp. 85:74, Oct, 1955.
11. Lentz, Edith What Is a Supervisor, Nursing Outlook 4:336, June, 1956
12. The Head Nurse at Work, New York, 1953, Department of Hospital Nursing, National League for Nursing, Inc
13. Wolff, Elizabeth L. Developing Procedures for Draping Patients, Am. J. Nursing 56:590, May, 1956
14. Blake, F. G.: The Supervisor's Task, Nursing Outlook 4:641, Nov., 1956.
15. Seyffer, Charlotte Principles of Supervision and Administration, Am. J. Nursing 51:257, April, 1951
16. Blizzard, G S Basic Procedures in Ear, Nose and Throat Operating Room, Mod Hosp. 82:114, March, 1954
17. Coronatus, Sister M Supplies and Equipment, Hosp Topics 31:98, May, 1956
18. Mohr, O Surgical Instruments, Hosp Management 82:106, Oct, 1956
19. Sewell, Stella Work Simplification of Instruments and Equipment in the Operating Room, Operating Room Supervisor & Nurse 27:5, Sept, 1956
20. Larsen, Sophia A Operating Room Market Basket, Nursing Outlook 5:100, Feb, 1957.
21. Hall, Edith D Surgical Instrument Guide for Nurses, ed 2, New York, 1956, Edward Weck & Co.
22. Crile, G., Jr, and Brown, R B The Treatment of Wounds; in Lewis' Practice of Surgery, Hagerstown, Md, 1955, W F Prior Co
23. Gross, R E: Surgery in Infancy and Childhood, Philadelphia, 1953, W B Saunders Co.
24. Maes, U, and Ilgenfritz, H. C Surgical Aspect Technic, in Lewis' Practice of Surgery, Hagerstown, Md, 1955, W F Prior Co, vol I.
25. Berry, E C, and Kohn, M L.: Introduction to Operating Room Technique, New York, 1955, McGraw Hill Book Co, Inc., chaps 7 9
26. Zintel, H.: Asepsis and Antiseptics, S Clin North America, New York Number 4:257, 1956.

CHAPTER 5

SUTURING TECHNIQUES TO ACCOMPLISH PROMPT WOUND HEALING

HISTORICAL SUMMARY

During most operations sutures are needed to control bleeding, bring the tissues together, and hold them in apposition until the wound is healed.[1-4]

References to man's effort to acquire better techniques for controlling bleeding vessels and closing wounds are found in medical writings as early as 2000 B.C.[5-7] There is evidence that during the Trojan War, Aesculapius, who became the god of medicine, used "cords" for ligating bleeding vessels. Hippocrates, born in 460 B.C., also wrote of using ligature cords rather than cauterizing the tissues[7, 8]

In the period following the decline of the Greco-Roman civilization, the surgeons of the Arabian school continued to preserve the science of surgery. They followed the existing techniques for closure of wounds with one important exception, which was the use of harp strings made from the intestines of sheep (Fig. 117). The writings of Rhazes constitute the earliest record of the use of surgical gut (catgut) as a suture material. However, the word "catgut" is actually a misnomer. The Arabic word "kit" means a dancing master's fiddle, but the word "catgut" has no relation to a cat.

During the Middle Ages the science of surgery was almost forgotten. It was not until the sixteenth century that sutures were again used. The revolutionary ideas and practices of such men as Ambroise Paré (1510-1590) and William Harvey (1578-1657) and others helped to advance the techniques of surgery.[9] Paré reintroduced the ligature and advocated natural healing of wounds, and Harvey published his findings on the control of hemorrhage in surgery.[6]

During the seventeenth century surgeons began using such materials as silk, flax cloth, and horsehair. For many years the surgeon left the ends of the suture protruding from the wound so that when the so-called pus appeared (which was usually the case), the sutures could be pulled from the wound to afford freer drainage.

In 1806 Dr. Philip Syng Physick, of Philadelphia, used sutures made of animal tissue (Fig. 118), and Dr Horatio Gates Jameson, of Baltimore, in 1820, placed buried sutures of animal tissue in wounds.[6, 10, 11] Because aseptic techniques were unheard of, primary union of wounds rarely occurred. Lister's teachings and his introduction of antiseptics about 1865 increased the use of su-

59. McCaskill, C., and Elsik, M.: Transporting Patients to the Operating Room, Nursing Outlook 4:562, Oct., 1956
60. Phelps, R. A.: Safeguarding the Operating Room Suite, Mod. Hosp 78:128, 1952
61. Dhunér, K G: Nerve Injuries Following Operations, Anesthesiology 11:289, 1950
62 Day, M: Effects of Positions on Vital Signs During Anesthesia, J. Am Nurse Anesthetist 23:178, Aug., 1955
63 Case, E H., and Stiles, J A: Effects of Surgical Positions on Vital Capacity, Anesthesiology 7:29, 1946.
64. Maier, H. C, Rich, G W, and Eichen, S: Clinical Signs of Respiratory Acidosis During Operations, Ann Surg. 134:653, 1951.
65. Allbritten, F, and Frederickson, E. L: Maintenance of Respiratory Function Following Injury, S Clin North America 10:1221, 1956.
66 Beer, G. E Pulmonary Function, J. Am Nurse Anesthetist 23:172, Aug., 1955
67 Mattson, S-B., and Carlens, E: Lobar Ventilation and Oxygen Uptake in Man—Influence of Body Position, J Thoracic Surg 30.676, Dec., 1955
68. Orr, R. B.. Respiratory Obstruction, S Clin North America 6:625, 1956
69 Slocum, H. C., Hoeflich, E. A., and Allen, C R: Circulatory and Respiratory Distress From Extreme Positions on the Operating Table, Surg Gynec. & Obst. 84:1051, 1947.
70 Hodgkinson, P. C, and Rood, R. C: Influence of Body Posture Upon Arterial and Venous Blood Pressure in Gynecological Surgery, Hosp Topics 31:66, July, 1953.
71. Allen, A, Linton, R., Donalson, G., and Quick, A: Postoperative Thrombosis and Embolism, Am J Surg 28:648, 1935
72 Best, C. H, and Taylor, N B.: The Physiological Basis of Medical Practice, Baltimore, 1953, Williams & Wilkins Co.
73. Slocum, H C, O'Neal, K. C, and Allen, C. R: Neurovascular Complications From Malposition on the Operating Table, Surg Gynec. & Obst 86.729, 1948.
74 Denny-Brown, D E., and Doherty, M M: Effects of Transient Stretching of Peripheral Nerve, Arch Neurol & Psychiat 54:116, 1945
75 Hunter, R. G, and others: Stirrups and Postoperative Backache, Obst. & Gynec. 4:344, 1954.
76. Westin, B. E: Prevention of Upper Limb Nerve Injuries in Trendelenburg Position, Acta chir scandinav. 108:61, 1954

KINDS OF SUTURES

Suture materials may be divided into two major categories: absorbable and nonabsorbable.

Since it was impossible to determine the absorption rate of various types of absorbable material (surgical gut) in terms of days, as previously established, the Committee of the United States Pharmacopeial Convention formulated a new definition for the absorption rate of several types of surgical gut.[25, 26]



Fig 118—Dr. Philip Syng Physick (1768-1837) was responsible for the development and use of nonabsorbable sutures for closure of wounds. (From Manual of Surgical Sutures and Ligatures, American Cyanamid Co, Surgical Products Division, Danbury, Conn)

Absorbable sutures are those which can be digested during the healing process by the tissues in which they are embedded. According to the statements recorded in the *United States Pharmacopeia*, XV revision, an absorbable surgical suture (catgut, surgical catgut, surgical gut) is a strand prepared from collagen derived from healthy mammals, purified, rendered sterile, and protected from contamination. It is either a plain strand which has not been treated in any manner that will alter its normal rate of digestibility (known as Type A, Plain or Untreated) or a strand which has been tanned or otherwise treated so that it will resist digestion for longer but varying periods of time and known accordingly as Type B, Mild Treatment; Type C, Medium Treatment; or Type D, Prolonged Treatment. In one form of treatment the suture is frequently referred to as chromic. The types mentioned are supplied as boilable or as nonboilable absorbable surgical gut sutures.[22, 25-27]

ture materials and helped to reduce postoperative wound infection.[9] This was the beginning of aseptic surgery. Lister found that bacteria in the strand, and not the suture alone, caused infection (Fig. 119). Because of the unsatisfactory results following the use of absorbable sutures, Kocher and Halsted began using "antiseptic" silk sutures.[12, 13]

Since 1909 many different kinds of suture materials have been developed for use in particular tissues.



Fig 117.—After the decline of Greco-Roman civilization, the surgeons of the Arabian school continued to follow the existing practices in preparing sutures from the intestines of sheep for closure of wounds (From Manual of Surgical Sutures and Ligatures, American Cyanamid Co, Surgical Products Division, Danbury, Conn)

Much of the pioneer work in the proper use of suture materials can be attributed to the observations and precepts established by Halsted, Howes, Burke, and others.[9, 14-17] Technical improvements are still being made in research, and the manufacturing, preparation and use of sutures to accomplish prompt primary wound healing.[18-24] To afford prompt wound healing, the essential requisites of a perfect suture are sterility, definite and measured absorbability, fineness, tensile strength at the knot, pliability, and economy.

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Nonabsorbable surgical suture is a strand of material that effectively resists enzymatic digestion in living animal tissue. It may be composed of metal or of organic material, and each strand is of substantially uniform diameter throughout its length.[28-32] It may be composed of a single filament or of filaments or fibers rendered into a thread by spinning, twisting, or braiding, or by any combination thereof. It may be coated or uncoated and may either be untreated for reduction of capillarity and designated as Type A, Untreated or Capillary, or be treated to reduce capillarity and designated as Type B, Treated or Noncapillary.[21] It may be uncolored, naturally colored, or dyed with a suitable dyestuff.

Surgical Gut

This absorbable suture now is entirely safe, from the standpoint of sterility, due to the elaborate processes of mechanical and chemical cleansing of the raw



Fig 119—To no individual does surgery owe more than to Joseph Lister (1827-1912) who applied aseptic methods based on the work of Louis Pasteur Lister's experiments with suture materials led to the development of modern surgical gut (From Manual of Surgical Suture and Ligatures, American Cyanamid Co, Surgical Products Division, Danbury, Conn)

gut, controlled heat sterilization, and storage in a hermetically sealed container. These manufacturing processes provide for the tensile strength, controlled absorption, and predictable results necessary to assist the surgeon in performing modern surgery.[27, 33, 31] To chromicize the gut strands, the tanning process is applied either to the submucosa ribbons before they have been twisted into the strand or to the finished strand after it has been formed from the ribbons. The strength of the chrome content and the duration of the chromicizing process are accurately controlled and tested.

Proper chromicizing of gut ensures the integrity of the suture and maintenance of its strength during the early stages of wound healing. It enables the wound with slow healing power to gather sufficient strength of its own before the suture is entirely absorbed. However, the absorption rate of surgical gut is influenced also by the type of body tissue it contacts and, to some extent, by the patient's general physical condition. Studies also show that surgical gut is absorbed several times as fast in serous or mucous membranes as in muscular tissues, and that when fine chromic gut is properly buried in successive layers of the gastrointestinal tract, it retains its strength for a sufficient length of time for primary union to take place.[15, 19, 30, 35]

Tensile Strength and Sizes of Surgical Gut.—To meet the *United States Pharmacopeia* specifications, surgical gut is spun into strands of various sizes, with maximum diameters ranging between those of the finest strand, size 6-0, and the heaviest strand, size 4. Chromic gut sutures tend to have slightly more tensile strength than sutures of plain gut.[14, 21] Fine surgical gut sutures are now being used in most patients because finer sutures provide for better suturing techniques and smaller knots[36] There is also less danger of necrosis from strangulation of tissues, because fine sutures are usually not tied too tightly.[36, 37] Studies indicate that the wound heals more quickly and with less tissue reaction when fine-gauged sutures are used. Modern suture practices also reveal that chromic gut is frequently used, rather than plain gut. Chromic gut, sizes 3-0 to 2-0, is commonly used for ligating small subcutaneous vessels; sizes 2-0, 0, or 1 for closing fascial layers; and sizes 5-0 and 6-0 for plastic and ophthalmic operations.[20, 21, 27, 38]

Boilable and Nonboilable Surgical Gut.—The terms "boilable" and "nonboilable" refer only to the method used to sterilize the exterior of the tube or envelope. During the manufacturing process, the suture and the inner surface of the container (made of glass, silver foil, or plastic material) have been sterilized and subjected to a series of physical and chemical tests plus bacteriologic examinations to prove their sterility.

The method of tubing or packaging nonboilable surgical gut provides the members of the operating team with sutures ready for use when removed from the container. The storage fluid in the tube or package, if present, consists of an alcoholic solution and a small amount of sterile, distilled water which has a softening effect on the surgical gut. Because of the presence of water, if the outside of the glass tube or package is sterilized by dry or moist heat, the gut will coagulate because it is a protein, therefore nonboilable sutures must not be subjected to heat.

To allow gowned and gloved members of the team to handle the glass tubed sutures or package during the operation, nonboilable sutures are stored in cans or glass jars in which the sutures are immersed in a solution containing a mixture of alcohol and formaldehyde. The tubes are ready to use when the can or jar is opened. After the jar is opened, if the storage solution containing formaldehyde contacts the inner surfaces of the jar and exterior of the glass tubes, the agent acts as a satisfactory disinfectant. When nonboilable tubed sutures are purchased in cardboard boxes, or when the tubes are contaminated in the operating room, they must be washed in lukewarm soapy water, rinsed and dried, and then immersed in a satisfactory disinfectant for 8 hours to destroy most types of bacteria.[39] If contaminated with serum, nonboilable tubes should be destroyed.

Nonboilable gut sutures are now packaged in transparent, hermetically sealed envelopes made from plastic material.[15] This method of packaging eliminates the glass tube. In opening the package, the suture will not be damaged on the edges, and the dangers caused by shattered glass in the operating room and in the laundry are eliminated. When packages are stored in a disinfectant, it does not contain formaldehyde. During a long exposure period, plastic envelopes may be damaged by a formaldehyde solution, thereby contacting and damaging the suture. The length of time the envelope should be immersed in the chemical agent is influenced by the types of bacteria to be destroyed, the characteristics of the envelope, and the reaction of the agent when in contact with it (Chapter 2). Grossly contaminated envelopes should be discarded, and those contaminated with vegetative bacteria, including tubercle bacilli, or those contaminated with spores proved to be susceptible to the chemical agent may be immersed for 3 to 8 hours. Other packaging methods are being developed which will ensure the safety of the patient and also eliminate the need to sterilize the exterior of the envelope. The use of sterile sutures packaged in envelopes decreases the time required to prepare sutures and provides for better suturing techniques.

Boilable Gut Suture.—The boilable gut suture is first dried and then sealed in the glass tube with an anhydrous solvent before it is exposed to dry-heat sterilization. Because of the absence of water in the tubing fluid, packaged boilable gut can be either exposed to heat sterilization or disinfected in the same way as are the nonboilable tubes. (Fig. 7.)

Because boilable gut is stiff, the strand must be immersed in sterile water for several seconds before it can be used.

Restoring Pliability of Surgical Gut.—To provide maximal pliability of nonboilable surgical gut sutures, the gut should be used immediately after removal from the tube or package When a gut suture is removed from its container and not used at once, the alcohol evaporates, and this in turn causes the strand to lose its pliability. If necessary, the gut suture may be placed between the folds of a towel which has been saturated with 95 per cent alcohol and placed in a metal basin on the sterile instrument table, or the gut suture may be placed between the folds of a dry sterile towel and the strand's pliability restored just prior to use, by immersing it in sterile normal saline solution, preferably at 37°C. If the latter method is used, the gut strand should be immersed for only a few seconds.

If boilable gut sutures are used, they may be conditioned by immersing them, as shown below, in sterile normal saline solution at 37° C. After the pliability of a boilable suture has been restored, it should be used immediately. The immersion periods for various sizes and types of surgical gut are as follows:

SIZE	PLAIN	CHROMIC
6 0, 5 0, 4 0	5 sec.	10 sec.
3 0, 2 0	10 sec.	15 sec.
0, 1	20 sec.	25 sec.
2, 3, 4	30 sec.	40 sec.

Boilable gut is rarely used, since, after removal from the tube, not only is the suture weaker than nonboilable gut, but it is necessary to restore its flexibility, and this results in further weakening.[11,30] Because of the time needed to prepare boilable gut, its use tends to increase costs, since during the preliminary preparation for an operation an unnecessary number of sutures are prepared and not used in the patient.

Other Absorbable Materials

Ribbon surgical gut is prepared in strips, each 17 inches long and ⅝ inch wide (Chapters 11 and 16). It is used to repair or support tissues in such operations as urethroplasty, hernioplasty, and nephropexy (Fig. 438).

Kangaroo tendon, made from the split tail tendons of this animal, is rarely used. However, it is sometimes used to suture bone fragment, support fracture lines, or repair a hernial defect.

Fascia lata is not a true absorbable suture, but it becomes part of the tissue after the wound has healed (Chapter 11). Fascia lata sutures are used to provide additional support to weakened fascial layers (Figs. 286 and 287). This material is obtained from the fibrous tissue which covers the thigh muscles of beef cattle; it is prepared in strips (each 8 inches long and ⅛ inch wide) and is packaged in a sterile container. When an autogenous graft is preferred, the fascia lata may be taken from the patient, usually the thigh (Chapters 11 and 17).

Cargile membrane is a thin sheet of pliable tissue obtained from the appendix of beef cattle, is purchased in sterile pieces, each 4 inches wide and 6 inches long. It is used to cover tissues from which peritoneum has been removed (Chapter 15).

Bone wax is not a suture, but is rubbed into the bleeding stomas on the surface of the bone to stop bleeding. The Horsley bone wax formula is beeswax, 87 parts; olive oil, 12 parts; salicylic acid, 1 part.[41] Modifications of this formula have been used by suture manufacturers in preparing sterile wax. In the immediate preparation of sterile wax for use in the patient, the gloved and gowned worker places the tubed sterile wax in warm sterile water for a few seconds, then opens the container and scoops out the wax. It is kneaded into small rounded pieces, then placed on a metal dish ready for use It is important to have wax of the proper consistency, because hard wax crumbles and soft wax will not plug a large vein or stick to a bony surface (Chapters 6 and 17).

To allow gowned and gloved members of the team to handle the glass tubed sutures or package during the operation, nonboilable sutures are stored in cans or glass jars in which the sutures are immersed in a solution containing a mixture of alcohol and formaldehyde. The tubes are ready to use when the can or jar is opened. After the jar is opened, if the storage solution containing formaldehyde contacts the inner surfaces of the jar and exterior of the glass tubes, the agent acts as a satisfactory disinfectant. When nonboilable tubed sutures are purchased in cardboard boxes, or when the tubes are contaminated in the operating room, they must be washed in lukewarm soapy water, rinsed and dried, and then immersed in a satisfactory disinfectant for 8 hours to destroy most types of bacteria.[39] If contaminated with serum, nonboilable tubes should be destroyed.

Nonboilable gut sutures are now packaged in transparent, hermetically sealed envelopes made from plastic material.[18] This method of packaging eliminates the glass tube. In opening the package, the suture will not be damaged on the edges, and the dangers caused by shattered glass in the operating room and in the laundry are eliminated. When packages are stored in a disinfectant, it does not contain formaldehyde. During a long exposure period, plastic envelopes may be damaged by a formaldehyde solution, thereby contacting and damaging the suture. The length of time the envelope should be immersed in the chemical agent is influenced by the types of bacteria to be destroyed, the characteristics of the envelope, and the reaction of the agent when in contact with it (Chapter 2). Grossly contaminated envelopes should be discarded, and those contaminated with vegetative bacteria, including tubercle bacilli, or those contaminated with spores proved to be susceptible to the chemical agent may be immersed for 3 to 8 hours. Other packaging methods are being developed which will ensure the safety of the patient and also eliminate the need to sterilize the exterior of the envelope. The use of sterile sutures packaged in envelopes decreases the time required to prepare sutures and provides for better suturing techniques.

Boilable Gut Suture.—The boilable gut suture is first dried and then sealed in the glass tube with an anhydrous solvent before it is exposed to dry-heat sterilization Because of the absence of water in the tubing fluid, packaged boilable gut can be either exposed to heat sterilization or disinfected in the same way as are the nonboilable tubes. (Fig. 7.)

Because boilable gut is stiff, the strand must be immersed in sterile water for several seconds before it can be used

Restoring Pliability of Surgical Gut.—To provide maximal pliability of nonboilable surgical gut sutures, the gut should be used immediately after removal from the tube or package. When a gut suture is removed from its container and not used at once, the alcohol evaporates, and this in turn causes the strand to lose its pliability. If necessary, the gut suture may be placed between the folds of a towel which has been saturated with 95 per cent alcohol and placed in a metal basin on the sterile instrument table; or the gut suture may be placed between the folds of a dry sterile towel and the strand's pliability restored just prior to use, by immersing it in sterile normal saline solution, preferably at 37°C. If the latter method is used, the gut strand should be immersed for only a few seconds.

suture in gastrointestinal procedures. Pagenstecher's linen, which is treated in much the same way as silk, is coated to produce a skin suture, and is sometimes used as a purse-string suture around the stump of the appendix (Fig. 318).

Horsehair has poor tensile strength and uneven diametric variations. It now has been replaced by other materials which are more efficient for suturing the skin edges of wounds.

Silkworm gut sutures are sometimes used for approximation of skin edges or for secondary suture line. Silkworm gut is made from the secreted fluid which is spun into silk by the silkworm to form its cocoon. The short strands must be immersed in warm sterile normal saline solution to make them pliable for use.

Umbilical cotton tape can be purchased in sterile tubes or on unsterile reels which must be sterilized by autoclaving. It is used for ligating or occluding tissue.

Metallic suture materials have been used for centuries. The metal sutures now used are made of stainless steel or tantalum.

Stainless steel sutures (the monostrand and the multistrand) and the stainless steel mesh are efficient supportive agents for use in certain conditions.[23, 28, 48] The multistrand stainless steel sutures (twisted) are made of several strands of a small diameter. They may be used for secondary repair of wounds, suturing of ligaments, tendons, bone fragments, or for repair of a hernia, cleft palate, or harelip defect (Fig. 120). Because of their maximum flexibility and tensile strength, fine-sized sutures can be used.[38, 49] They do not corrode in the tissues and the action of the metallic ions does not cause wound pain. The worker should not bend these sutures and should handle the ends carefully to prevent tearing his gloves. The operator ties a square knot in the suture, applies adequate tension to approximate but not constrict the tissues, cuts the ends of the suture close to the knot, or leaves the ends fairly long, and then turns them toward or into the tissues.

Stainless steel mesh may be used for the repair of a hernia or in large defects in which the soft tissues cannot be approximated readily with sutures (Chapter 11). Stainless steel wire mesh acts as a substitute fascial layer until granulations grow into the wire, thus encapsulating it in the connective tissue layer. The wire mesh sheets should be washed with soap and water, rinsed in water and alcohol, and then heat-sterilized. The sheet must be of sufficient size to cover the defect and allow its edges to be folded over about 1/4 inch, thus ensuring a smooth surface and a double thickness through which stainless steel wire sutures are placed. Wire scissors are needed to cut the mesh sheet and the loose strands, which should not be pulled out (Fig. 120).

Tantalum is a bluish gray metal which is inert and nonirritating to body tissues, and which possesses high tensile strength when it is embedded in the wound. Tantalum gauze and sutures provide for satisfactory support in the repair of a defect.[29, 50] Tantalum skull plates are fastened in the wound with tantalum screws or tantalum wire, and tantalum guaze is sutured with fine-gauge tantalum wire sutures. When this material is implanted in the tissue, fibroblasts form around it so that it becomes a part of the tissue layer. Tantalum should be heat-sterilized.[28, 51, 52]

Nonabsorbable Suture Materials

These suture materials are not absorbed in tissues during the process of wound healing and, generally, the material remains encapsulated or walled off by the tissues around it.[32, 37, 42, 53] In skin suturing, where nonabsorbable materials are often the choice, the sutures are removed before healing is complete. *The skin edges may be approximated with metal clips, which are described later* in this chapter.[5, 45, 46] The most common nonabsorbable materials are silk, nylon, cotton, and stainless steel wire.[24, 29, 47, 48, 53]

Surgical silk is the most widely used nonabsorbable suture material. It is prepared from the thread spun by the silkworm larva in making its cocoon. The strands of silk are either twisted or braided to form the suture. The braided type is most frequently preferred, because of its high tensile strength and better handling qualities. Untreated silk has a capillary action which, in turn, permits infection to be drawn into the wound. For this reason modern surgical silk is treated, to render it serum-proof and able to withstand the action of body fluilds and moisture.[3, 14, 24]

Braided surgical silk may be purchased on spools, in precut lengths, in sterile containers, paper envelopes, a self-dispensing paper unit, or a double envelope, of which the outer envelope (made of plastic laminated foil) is hermetically heat-sealed. Because silk shrinks when it is exposed to heat, a small amount should be removed from the original spool and should be loosely wound onto a reel or spool, then wrapped loosely in a muslin cover and sterilized with saturated steam.[40] This is the safest way to sterilize these sutures, even though they lose a certain amount of tensile strength (Chapter 2).

Silk is considered to be an efficient suture when fine sizes are used, when perfect aseptic techniques are applied, and when the tissues are not infected. The Halsted silk technique, which is commonly used, includes cutting the suture ends close to the knot, using fine-sized interrupted sutures, and carrying out aseptic measures.[11, 12, 37, 39]

Surgical cotton sutures are made of twisted cotton fibers. They differ from silk sutures in that cotton gains tensile strength when wet, but silk is the stronger suture.[31, 43, 47] Fine cotton sutures, when buried in tissues, produce minimum tissue reaction.[53] Ordinary sewing cotton, however, lacks the required tensile strength and smoothness throughout the strand and is difficult to handle. Sterilization of cotton and other nonabsorbable sutures is described in Chapter 2.

Surgical nylon is a synthetic polyamide material It is available in two forms: multifilament (braided) and monofilament strands. The multifilament nylon is relatively inert in tissues and has a high tensile strength. It is used in conditions similar to those in which silk or cotton is employed. Because of its elasticity, the operator usually ties three knots in the small-sized sutures and a double square knot in the larger-sized sutures. The monofilament suture is a smooth noncapillary material used for closing skin edges or for tension sutures (Fig 121).

Surgical linen is made of twisted linen thread which possesses sufficient tensile strength but is rarely used as suture material except as a transfixion

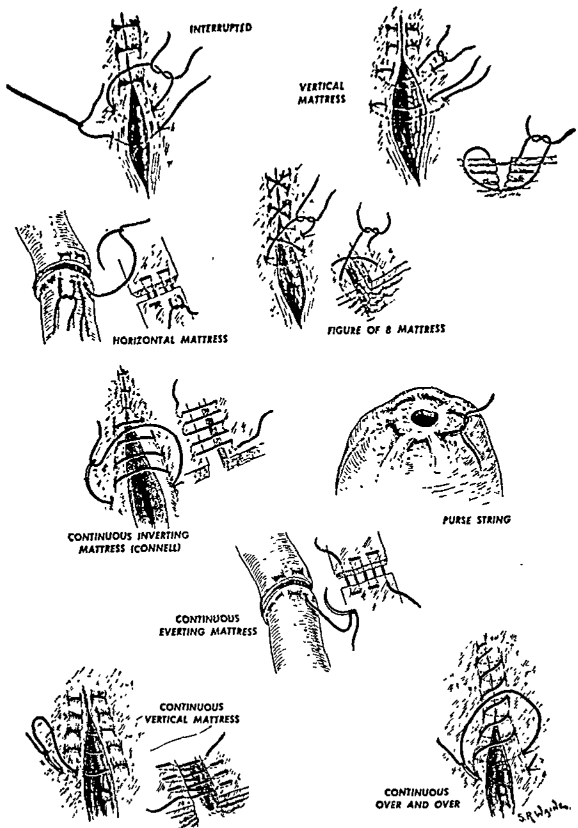


Fig 121 —The various methods for the closure of wounds, so that the edges of the wound will remain in apposition until the wound has healed. (From Manual of Surgical Sutures and Ligatures, American Cyanamid Co, Surgical Products Division, Danbury, Conn)

Metal clips. Cushing or Frazier clips are made of pieces of stainless steel wire of a small diameter and are heat-sterilized. In neurosurgery and some orthopedic procedures, they are applied to the ends of severed nerves or blood vessels by means of a forceps designed for this purpose.[15, 46] Wire skin clips are also available to approximate the wound edges or to secure skin towels or stockinet to the incised skin. Even though skin clips tend to produce scarring, they may be used when the wound is infected, or when saving time is important to the patient's physical welfare.

Silver wire, silver foil, and silver hemostasis clips are used to control bleeding vessels. Silver clips are most frequently used in neurosurgical procedures. Silver possesses some antiseptic power in tissues but often causes irritation.[46]

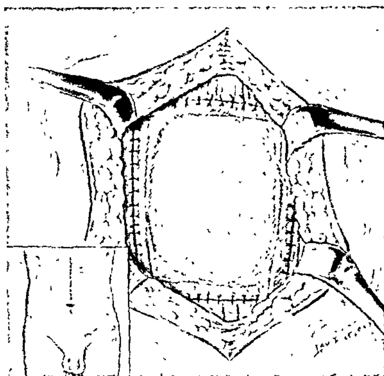


Fig 120 — The stainless steel mesh has been sutured in place, using stainless steel wire sutures, in the repair of a recurrent hernia (Courtesy American Cyanamid Co., Surgical Products Division, Danbury, Conn)

SUTURING METHODS

The primary suture line refers to those sutures which hold the edges of the wound in approximation until the wound is fairly well healed. The secondary suture line refers to those sutures which supplement the primary suture line, obliterate dead space, and prevent serum from accumulating in the wound. Buried sutures are those which are placed completely under the epidermal layer of the skin.[4, 10, 53]

A ligature is a strand used to encircle or close off the lumen of a vessel, to effect hemostasis, close off a structure, or prevent leakage of materials.

A suture ligature, "stick" tie, or transfixion ligature is a strand of suture material threaded on a needle. The needle is used to prevent the ligature from

or common duct, it may be secured to the wall of that organ with an absorbable suture.

SURGICAL NEEDLES

Various types and sizes of surgical needles are constructed to suit different-sized sutures and the composition of body tissues. These needles fall into three general groups: (1) the eyed needles, those in which the strand must be threaded, thus making it necessary to pull two strands of material through the tissue; (2) the split-eye (French) needles, in which the strand can be drawn quickly through the slit of the needle, and (3) the needle-suture combination (eyeless needles), in which a needle is attached to one or both ends of the suture which has a diameter almost equal to that of the needle (Fig. 122).

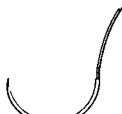
The needles selected for various procedures depend on the characteristics and condition of the tissue or vessels to be sutured, their location and accessibility, the size of the suture material, and the preference of the surgeon. Needles are designed in many different shapes, thicknesses, and sizes. The common

EYED NEEDLES


Round


Square


French or Split

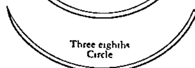

Atraumatic® Needle

NEEDLE SHAPES (PROFILE)


Half Curved


Straight


Half Circle


Three eighths Circle

NEEDLE SHAPES (SECTION)


Taper


Cutting


Inverted Cutting


Elliptron*
* Trademark

Fig 122 —The basic design of surgical needles (From Manual of Surgical Sutures and Ligatures, American Cyanamid Co, Surgical Products Division, Danbury, Conn)

slipping off the end of the vessel or structure (Fig. 121). When two ligatures are being used to ligate a large vessel, usually the free ligature is placed on the vessel and then the transfixion ligature is placed distal to the first ligature. To ligate a blood vessel situated in the deep tissues, the strand must be of sufficient strength and length to allow the operator to tighten the first knot. The strand is applied, using one of several techniques: (1) A forceps of proper design is placed on the end of the structure; then the suture ligature secured in a forceps is placed over the vessel. The knot is tied and tightened by means of the operator's fingers or with the aid of forceps. (2) A special slip knot is made, and its loop is placed over the involved structure by means of a forceps. (3) A forceps is applied to the structure and then the transfixion sutures are applied and tied (Fig. 121). The preparation of ligatures and suture ligatures is discussed in a later section of this chapter.

An interrupted suture is inserted in tissues or vessels in such a way that each stitch is self-contained and tied. This type of suture is the most widely used and generally considered to be the most efficient (Fig. 121). Various techniques are used for the insertion of interrupted sutures in the tissue, resulting in a mattress suture, vertical, horizontal, or crossed in a figure-of-eight stitch. These techniques are designed to alter the angle of pull and the relationship of the wound's edges to each other. Such maneuvers cause the edges of the wound to either invert or evert; and this, in turn, aids in wound healing with fewer sutures being used. Procedure for handling sterile sutures is discussed in Chapter 11.

A continuous suture consists of a series of stitches, of which only the first and last ones are tied (Fig 121). This type of suture is not widely used, because a break at any point may mean a disruption of the entire suture line. It is used, however, to close a tissue layer, such as the peritoneum, which does not have great strength but requires a tight closure to prevent the intestinal loops from protruding.

A purse-string suture is a continuous suture which is placed in such a way that it surrounds an opening in the structure and causes it to close. This type of suture may be placed around the appendix before removal or may be placed in the cecum prior to opening it, so that a drainage tube can be inserted. (Chapter 14.)

A tension or stay suture provides for a secondary suture line. These sutures, which are placed at a distance from the primary suture line, relieve undue strain and help to obliterate dead space They are placed in the wound in such a way as to include most, if not all, of the layers of the wound. A simple interrupted or a figure-of-eight stitch is used (Fig. 121) Usually heavy, nonabsorable suture materials, such as nylon or wire, are used to close long vertical abdominal wounds and lacerated or infected wounds To prevent the suture from cutting into the skin surface, a small piece of rubber tubing or other type of "bumper" is passed over or through the exposed portion of the suture.

To Hold a Drain in Place.—If a drainage tube is inserted in the wound, the tube may be anchored to the skin with a nonabsorbable suture so that it will not slip in or out. If a tube is left in a hollow viscus, such as the gall bladder

or suture pad; grasp the tube in such a way that the thumbs rest on either side of the engraved score mark. (3) Break the tube, using a movement which tends to bend the ends of the tube backward toward the body. (4) Open the towel carefully over a basin designated for this purpose and pull out the suture, making sure that it does not touch the edge of the broken glass. (5) Be sure to break the tube over a basin on the instrument table and to discard the broken glass in the basin, to prevent glass particles from being picked up and transferred to the wound by means of gauze or instruments.

Opening a Plastic Envelope.—The gowned and gloved nurse cuts open the package near the hermetically sealed edge (using suture scissors), then removes the coiled strand and label. The worker should follow the manufacturer's written instructions concerning the preparation and handling of such sutures.

Uncoiling Sutures.—Nonboilable gut sutures should be removed from the reel immediately. As mentioned previously, boilable gut must be conditioned before it is uncoiled.

To remove the fiber reel from a suture which does not have a needle attached to it, the gowned and gloved worker breaks off parallel tabs or prongs at the ends of the reel, bends them slightly, and then slips the coiled suture off the reel onto the fingers of the free hand (Fig. 123). To uncoil a long suture, grasp its free end (using the thumb and forefinger of the free hand), uncoil one half the strand, remove the kinks by pulling it gently, and then uncoil the remaining portion of the strand. Secure the free ends in one hand and the center loop in the other, then slowly abduct the arms slightly to straighten the strands (Fig. 124).

Kinks should never be removed by running the fingers over the strand; and the tensile strength of a gut suture should not be tested before handing it to the surgeon. Sudden pulls or jerks used to test the tensile strength of a suture may damage it so that it will break when in use.

To uncoil sutures which are not on reels, the gowned and gloved worker should grasp the center loop with one hand and the free ends with the other and then remove the kinks by slowly abducting the arms (Figs. 125 and 131).

In some hospitals, spiral wound sutures are used. A long suture (surgical gut, silk, or cotton) is wound on a cylindrical fiber reel. The surgeon holds the reel in his hand as he ligates the bleeding vessels. This technique eliminates the need to rewind sutures on reels, saves nurses' time, and eliminates waste motion.[55]

To uncoil a suture-needle combination, the gowned and gloved worker grasps the free end of the suture with the fingers of one hand; then, holding the strand some distance from the needle with the other hand, she gently pulls the strand to straighten it. She places the jaws of the needle holder on the center of the flattened surface of the needle to prevent breakage and bending.

Cutting Suture Lengths.—A suture or free ligature should not be too long or too short. A long suture is difficult to handle and increases the possibility of contamination because it may be dragged across the sterile field or fall below it.[34, 38, 57] A short suture usually slips from the eye of the needle as it is being inserted and makes tying most difficult.

For general surgery, a continuous suture is usually about 24 inches long after threading, and its short end is 3 to 4 inches long.[26] An interrupted suture is 12 to

shapes are straight, half-circle, half-curved, and three-eighths-circle (Fig. 122). The common types of needle points are cutting edge, triangular or spear, trocar, and taper (Fig. 122). The size designations of eyed or split-eyed needles are confusing. The number used to designate a size does not always indicate that all types of needles with that number are of the same dimension. In curved needles, the number or size may refer to the cord measurement, which is the span between the point and the eye of the needle. Also, the size of the eyed needle does not refer to the length or cord, but to the initial length of the steel before the needle is made.

To prepare needles, they should be threaded through a gauze pad or secured in a metal rack and then wrapped in muslin and sterilized with dry heat for one hour at 320° F.[40] (Chapter 2). Steam under pressure causes needles to erode.

Needles should be made of properly tempered steel which will not break, turn, or bend when properly inserted into the tissues. The design of the needle must provide for flexibility, a flattened surface on which to secure the needle holder, and sufficient strength to withstand the force placed on it.

The swaged-on needles are now preferred, rather than the eyed needles. The needle-suture combination is always ready for use as it is removed from its sterile container. The needle holder should be placed only in the center of the flattened surface designed as a part of the swaged-on needle. The operator works with a new, sharp needle which is properly designed so that it causes minimal trauma as it is drawn through the tissues. The use of swaged-on needles also eliminates the job of threading small-eyed needles before or during surgery. Studies indicate that the use of swaged-on needles provides greater safety to patients and provides for economy in materials and in workers' time.

The operating room teams should institute a plan for standardizing needle and suture sets for various types of operations, evaluating methods for keeping needle counts during surgery, and handling soiled needles. Such procedures should be described in the nursing procedure book (Chapter 4).

SUTURING TECHNIQUES

In the preparation and use of sutures in surgery, every precaution must be taken to keep the sutures sterile and to prevent prolonged exposure and unnecessary handling.[4, 10, 54, 55] Before the nursing members of the team prepare the sutures for the patient, they should review the sutures listed in the card file for the particular procedure and operator. The scrubbed nurse should prepare only one or two sutures during the preliminary preparation, but should have an adequate supply of sutures available on the sterile instrument table. Using suture materials packaged in transparent plastic envelopes provides for sterile sutures ready for use, reduces the length of time previously needed to prepare them, and decreases waste.[18]

Opening a Glass Tube.—The gowned and gloved worker should carry out the following steps (1) Take a tube in the fingers of one hand; shake the suture down to one end of the tube (a distance well below the score mark), thus avoiding cutting the suture when removing it (2) Wrap the tube in a sterile suture towel

14 inches long, with 2 or 3 inches threaded through the needle. To ligate a vessel in the epidermal and subcutaneous layers, the ligature may be 12 to 15 inches long. However, those vessels or structures deep in the wound are ligated with a suture 24 to 30 inches long. (Figs. 132 to 134.)

Figs. 125 to 131.—Uncoiling and dividing a strand into four equal parts for ligatures. (From Alexander, E: Nurses Evaluate a Suture Package, Mod. Hosp. 88:65, 1957.)



Fig. 125.—The scrubbed nurse grasps the double end of the coil with her free hand and slides the thumb and index finger of the other hand onto the free ends, leaving the coil hanging free.

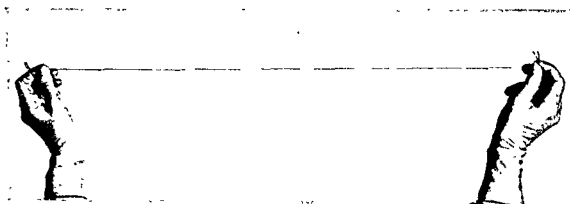


Fig 126.—Quickly pulling her hands apart, the nurse straightens the double strand.

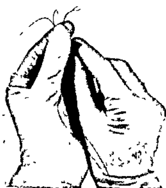


Fig 127.—To prepare the ligatures, the nurse brings her hands together and places the folded end of the strand between the index finger and thumb that are holding the free ends as shown

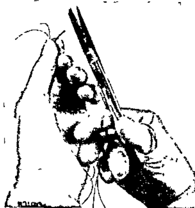


Fig 128—To prepare a suture, the double strand is cut



Fig 123—To remove suture from fiber reel, the gowned and gloved worker breaks off the prongs or tabs, bends the reel, then slips the coiled strand onto the fingers.



Fig 124—The long gut strand is uncoiled and then gently pulled to remove the kinks.

Threading Surgical Needles.—The worker pulls the suture through the needle's eye about 4 inches, to prevent the suture from being pulled out of the eye during suturing (Fig. 135). A curved needle is threaded from within its curvature so that the short end falls away from the outside curvature. This helps prevent a too easy pull-out. To keep the needle secure in the jaws of the holder and prevent damage to the eye of the needle, the needle holder is placed on the flattened surface of the needle and ⅛ inch away from the eye.

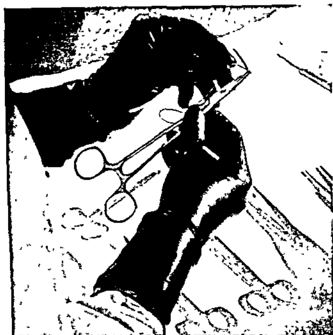


Fig 135—To thread a curved needle, the gowned and gloved worker holds the needle holder with needle between the first two fingers and thumb of one hand, and rotates the arm and wrist slightly outward to insert end of strand through eye from within the needle's curvature.

Applying Principles of Body Mechanics.—An efficient method for handling sutures is based on aseptic principles and motion and time studies.[10, 12, 56] The steps to be studied include transporting, grasping, positioning, and holding sutures. The elimination of steps and the better use of body motions serve to reduce fatigue, make work easier, and ensure asepsis.

For example, to prepare a suture for the operator, the steps include grasping the shank of the needle holder with the cushions of two fingers and the thumb (Fig 135) and rotating the arm and wrist (Fig. 136). Secure the long end of the suture between the palm and little finger of the same hand, rotate the arm inward, and slightly flex the elbow to bring the rings of the holder into the correct holding position for the operator; then transport the suture near his hand. Hold the needle holder as he positions his fingers on the rings, and then hand the free end of the suture to the assistant operator (Figs. 137 and 138).

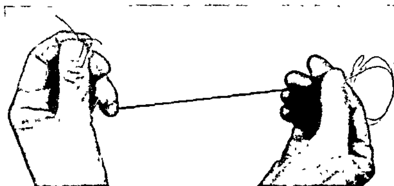


Fig 129—The nurse flexes her fingers over the strand, grasps the two double free ends with the free fingers and thumb, and brings the double ends together with the other ends of the strand.



Fig 130—The nurse grasps the scissors and divides the double strand to make four ligatures

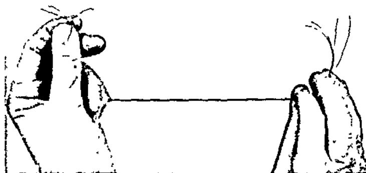


Fig. 131—The four strands are shown.

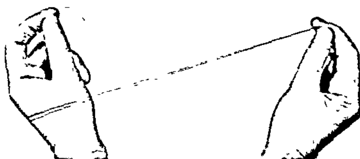


Fig 132—To divide the 27-inch double strand into three equal lengths, the nurse turns the hand that is holding the two free ends of the strand so as to loop the strand back around the hand to the free ends

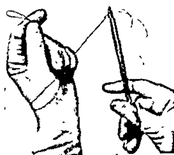


Fig 133—She then grasps the scissors and divides the strand into three equal lengths.

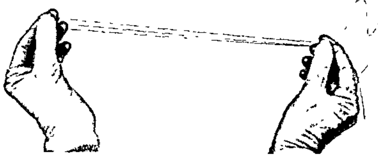


Fig 134—Then she places the three lengths together (suture-ligatures)

Smooth, continuous motions of the hands are preferable to zigzag or straight-line motions which involve sudden, sharp jerks or changes in direction.[56, 57] Rhythm is essential to the smooth, automatic *performance of handling sutures* and instruments during surgery. Motions requiring a minimum of time should always be used whenever possible. Such motions include those of the fingers, wrist, and forearm.

During the operation, the scrubbed nurse should arrange the sutures for closure of the wound on the sterile Mayo (portable) stand in the order in which they are to be used (Chapters 4 and 11). When interrupted sutures are used, the scrubbed nurse prepares another suture while the operators place the previous one in the tissues. The surgeon returns the needle holder and needle to the nurse

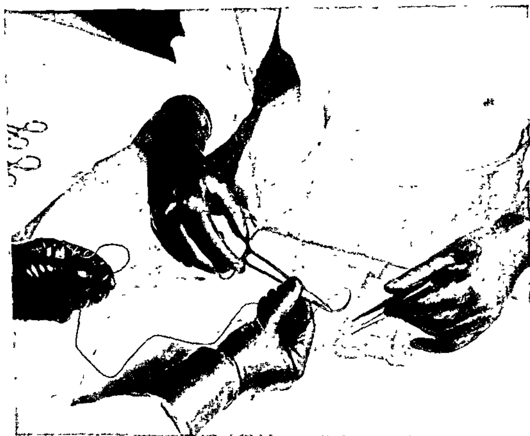


Fig 138—The gowned and gloved worker uses a rotation movement, and turns the rings of the needle toward the operator's hand in position for use. Notice the needle holder is secured to the flat portion of the swaged-on needle, away from the eye; also the worker's hand is at a right angle to the needle holder and not in the operator's way. The end of the suture is held ready for the assistant to grasp it.

before he uses another suture. Tissue forceps without teeth are needed to aid the surgeon in grasping the ends of the sutures. All needles, with or without eyes, are accounted for prior to closure of the *peritoneum and the skin* (Chapter 4). The operating room committee, who accept the responsibility for establishing standard suture sets for *various operations, should consult the guides published* by suture manufacturers. These guides, which list the recommended suture materials for various wounds, are based on current practices and studies.[27]



Fig 136—The gowned and gloved worker, keeping the fingers in the same position on the holder, rotates the arm slightly inward to bring the short end of suture away from the outside curvature of the needle

Fig. 137—The gowned and gloved worker brings the long end of the suture away from needle and holder toward back of hand, and secures long end of suture between finger and palm of hand in preparation to hand suture to the operator She grasps the tissue forceps with fingers of other hand so that the operator can place his fingers on the forceps in position for use.

Healing is delayed in the presence of infection, poor coaptation of tissues, pronounced anemia, or general debilitating disease, such as cancer and diabetes. In these patients, scar tissue may form and the wound may break down later, resulting in hernial defects, ulcers, or deformities. Infection, however, is the most common cause of delayed wound healing. Poor wound healing may also result from poor medical and surgical aseptic techniques.[38, 59] Such errors may include improper masking of the operating team, an unclean operating room, inadequate preparation of the proposed operative site, improper draping of the patient with sterile sheets, exposure of the wound's skin edges during surgery, undue pressure on the tissues from retractors, use of dry laparotomy pads and sponges, or poor suturing techniques (Chapters 2, 3, and 4).

Wound disruption occurs in only a small percentage of aseptic wounds, but, when it does, it is a most distressing and serious complication. In abdominal wounds, the intestines disrupt or eviscerate onto the skin.[3, 36, 54, 65]

Measures to control the incidence of wound separation and evisceration are (1) carrying out preoperative and postoperative measures to correct the patient's poor nutritional status, fluid and electrolyte balance, and dehydration; (2) handling tissues carefully and providing absolute hemostasis; (3) closing each layer carefully and obliterating dead spaces; (4) bringing a drain through a stab wound rather than through the original incision; (5) carrying out safety measures to reduce undue strain of the suture line and to permit proper functioning of the circulatory and respiratory systems by keeping the body in proper alignment and suctioning away tracheobronchial secretions; and (6) controlling abdominal distention, using nasogastric suctioning.

If the wound dressings become tinged with pink serosanguineous fluid, a wound evisceration should be suspected. When evisceration is evident, the nurse should not leave the patient, but should try to give him the assurance he needs, and should keep him as quiet as possible. The doctor should be notified immediately. The wound dressing should not be removed, but only reinforced, and the patient usually is given a sedative. The operating room is prepared for him immediately, and he is transported to surgery in his bed. The wound dressings are not removed until everything is in readiness to cope with the possible evisceration.

REFERENCES

1. Caulfield, P A, and Madigan, H S: Fundamentals of Wound Healing, Am. J. Surg. 86:249, 1953.
2. Howes, E. L: The Immediate Strength of the Sutured Wound, Surgery 7:24, 1940
3. Joergensen, E. J, and Smith, E. T: Postoperative Abdominal Wound Separation and Evisceration, Am. J. Surg 79 282, 1950.
4. Pick, J F: Surgery of Repair, Philadelphia, 1949, J. B Lippincott Co
5. Ballance, Sir C A.: A Glimpse Into the History of Surgery of the Brain, Seven Lectures, Dec 8, 1921, London, 1922, The Macmillan Co.
6. Garrison, F. H: An Introduction to the History of Medicine, ed 4, Philadelphia, 1929, W. B. Saunders Co
7. Harvey, S. C: History of Hemostasis, New York, 1929, Paul B Hoeber, Inc.
8. Lister, J. L: On the Antiseptic Principles in the Practice of Surgery, London, 1867, London Press, Inc.

In the selection of suture materials, several factors should be taken into consideration: namely, the age of the patient, the condition of the tissues, the characteristics of tissues or vessels, the nutritional status of the patient, and the presence of disease[10, 12, 30, 55, 58]

WOUND HEALING

Nature has the ability to repair defects by restoring continuity of like or unlike tissues. However, it may not always restore function of tissues, due to mechanical interference or complicating diseases. If the edges of an aseptic wound are apposed and maintained in correct position, prompt healing usually results.[1, 10, 12, 37, 38]

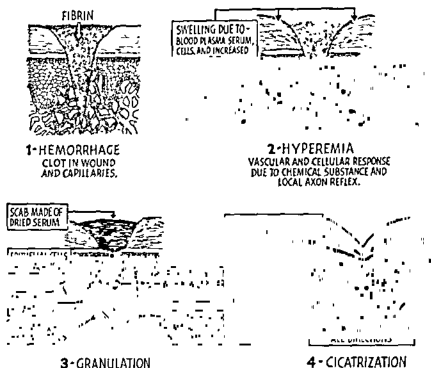


Fig 139—Diagram indicating changes in wound healing (From Berman, J. K: Principles and Practice of Surgery, St Louis, 1950, The C V. Mosby Co)

The biologic process by which repair of an aseptic closed wound takes place is as follows: Due to the action of fibrinogen, the blood clots, and within several hours after surgery, exudate forms between the divided tissues (Fig. 139). During the first two postoperative days, the edges of the wound are loosely brought together by the fibrin in the exudate On the third or fourth day, the fibroblasts begin to form collagen. Usually by the sixth day, the wound is filled with fibroblasts and the collagen shrinks and hardens, thus increasing the strength of the wound. On the patient's sixth postoperative day, healing is almost one third completed; after the tenth day, his wound is fairly well healed and becomes progressively stronger.[10]

The healing process is most effective when the patient is in a good state of nutrition and has an adequate supply of vitamin C and other nutritional foods.

42. Kerklin, J. W., Murphy, F., and Berkson, J.: Suture of Peripheral Nerves, Surg. Gynec. & Obst. 88:719, 1949.
43. Manual of Operative Procedures, Somerville, N. J., 1951, Ethicon Suture Laboratories, Inc.
44. Osler, Sir William: Principles and Practice of Medicine, ed. 4, New York, 1901, Appleton, Inc.
45. Adson, A. W., and Fincher, F. F.: Hemostatic Scalp Clips, J. A. M. A. 101:276, 1933.
46. Cushing, H.: The Control of Bleeding in Operations for Brain Tumors With Description of Silver Clips, Ann. Surg. 54:1, 1911.
47. Ashley, L. B., Brooks, C. D., and Thorstad, M. J.: The Use of Cotton Sutures in Surgery, Harper Hosp. Bull, (Detroit) nos. 3-6, 1941.
48. Preston, D. J.: Repair of Abdominal Hernia With Steel Cloth Implant, J. Internat. Coll. Surgeons 10:513, 1952.
49. Chasse, R. L: The Use of Steel Wire, J. Maine M. A. 42:289, 1951.
50. Mayfield, F. H., and Levitch, L. A.: Repair of Cranial Defects With Tantalum, Am. J. Surg. 64:319, 1945.
51. Brewer, J. H.: The Use of Tantalum Wire and Foil in Repair of Peripheral Nerves, S. Clin. North America 24:1491, 1943
52. Fulcher, O. H. L: Tantalum as a Metallic Implant to Repair Cranial Defects, J. A. M. A. 12:931, 1943.
53. Pariera, M. D: Reactions in Surgical Wounds to Surgical Gut and Cotton Sutures, Arch. Surg. 58:308, 1949.
54. Butler, D B: Wound Disruption—Questions and Answers, M. Times 81:539, 1953.
55. Mayo, C. W., and Madison, J. L: Separation of Abdominal Wounds, A M. A. Arch. Surg. 62:882, 1951.
56. Barnes, R. M: Motion and Time Study, New York, 1950, John Wiley & Sons, Inc.
57. Manual of Surgical Knots, Somerville, N J., 1955, Ethicon Suture Laboratories, Inc.
58. Brooks, B, and Duncan, G: Effect of Pressure on Tissues, Arch. Surg. 40:696, 1940.
59. Howe, C. W.: Causes of Failure in Antibiotic Therapy, S Clin North America 39:1351, 1955.

9. Leonardo, R. A.: History of Surgery, New York, 1943, Froben Press.
10. Berman, J. K.: Principles and Practice of Surgery, ed. 2, St. Louis, 1950, The C. V. Mosby Co.
11. Surgical Experience With Fine Size Sutures, Somerville, N. J., 1951, Ethicon Suture Laboratories, Inc.
12. Altemeier, W. A., and Stevenson, J. W.: Physiology of Wound Healing; in Davis, Loyal, (ed.). Christopher Textbook of Surgery, ed. 6, Philadelphia, 1956, W. B. Saunders Co
13. MacCallum, W. G.: William Stewart Halsted, Baltimore, 1930, Johns Hopkins Press.
14. Howes, E. L., and Harvey, S. C.: The Clinical Significance of Experimental Studies in Wound Healing, Ann Surg. 102.911, 1935.
15. Howes, E. L.: How to Use Catgut, Surg. Gynec. & Obst. 73:319, 1941.
16. How to Get the Most Out of Your Catgut Suture, Somerville, N. J., 1949, Ethicon Suture Laboratories, Inc.
17. Burke, J.: A Consideration of the Suture Problem, Am. J. Surg 49:303, 1940.
18. Alexander, Edythe L: A New Suture Packaging, Mod. Hosp 88.65, May, 1957.
19. Bower, J. O., Burns, J. C., and Mengle, H. A.: The Superiority of Very Fine Catgut in Gastrointestinal Surgery, Am. J. Surg. 47:20, 1940.
20. Bower, J. O., and Pearce, A. E: The Superiority of Fine Catgut Over Fine Silk as a Mucosal Suture in Gastric Surgery, Surg. Gynec. & Obst. 74.649, 1942.
21. Jenkins, H P., and Hrdina, L. S.: Absorption of Surgical Gut (Catgut). II. Pepsin Digestion Tests for Evaluation of Duration of Tensile Strength in the Tissues, Arch. Surg 44:984, 1942.
22. Jenkins, H. P., Hrdina, L. S, Owens, F. M., and Swisher, F. M: Absorption of Surgical Gut (Catgut), Arch. Surg. 45:323, 1942
23. Madsen, E T.: An Experimental and Clinical Evaluation of Surgical Suture Materials II, Surg. Gynec. & Obst. 97:73, 1953.
24 Shambaugh, P.: The Silk Technique, Surgery 7:9, 1940
25. Suture Handbook, Somerville, N. J, 1953, Ethicon Suture Laboratories, Inc.
26. Manual of Sutures, Danbury, Conn, 1953, Surgical Products Division, American Cyanamid Co.
27. Suturegrams, Danbury, Conn, 1952, Surgical Products Division, American Cyanamid Co.
28 Jones, T. E, Newell, E T., and Brubaker, R E: The Use of Alloy Steel Wire in the Closure of Abdominal Wounds, Surg Gynec. & Obst 72:1056, 1941.
29. Koontz, A R Tantalum Mesh in the Repair of Large Ventral Hernias, Surg Gynec. & Obst. 93:112, 1951
30. Localio, S A, Casale, W, and Hinton, J. W: Wound Healing—Experimental and Statistical Study, Surg Gynec & Obst 77:243, 369, 376, 481, 1943
31 Meade, W. H., and Long, C. H The Use of Cotton as a Suture Material, J. A M. A 117:2140, 1941
32 Fasanella, R M., and Freeman, D· Use of Fine Alloy Steel Wire Sutures in Ophthalmic Surgery, A M A. Arch Ophth 53:404, 1953
33 Jenkins, H P: A Clinical Study of Catgut in Relation to Abdominal Wound Disruption, Surg Gynec & Obst 64.648, 1937
34 Taylor, F. W: Surgical Knots and Sutures, Surgery 5:498, 1939.
35 Garlock, J H, and Lyons, A S· The Surgical Therapy of Duodenal Ulcer, Surgery 25.352, 1949.
36 Wolff, W I Disruption of Abdominal Wounds, Ann Surg 131.534, 1950.
37. Nelson, C. A, and Dennis, C Wound Healing, Surg Gynec & Obst. 93:461, 1951.
38. Whipple, A O· Essentials in Clean Wound Healing, Surg Gynec & Obst 70.257, 1950
39 Spaulding, E H Chemical Disinfection of Surgical Instruments; in Reddish, G. F.: Antiseptics, Disinfectants, Fungicides, Chemical and Physical Sterilization, Philadelphia, 1954, Lea & Febiger, chap 26
40 Perkins, F.· Principles and Methods of Sterilization, Springfield, Ill, 1956, Charles C Thomas, Publisher, p. 144
41. Horsley, V.: Antiseptic Wax, Brit M J 1:1165, 1892

42. Kerklin, J. W., Murphy, F., and Berkson, J.: Suture of Peripheral Nerves, Surg. Gynec. & Obst. 88:719, 1949.
43. Manual of Operative Procedures, Somerville, N. J., 1951, Ethicon Suture Laboratories, Inc.
44. Osler, Sir William: Principles and Practice of Medicine, ed. 4, New York, 1901, Appleton, Inc.
45. Adson, A. W., and Fincher, F. F.: Hemostatic Scalp Clips, J. A. M. A. 101:276, 1933.
46. Cushing, H.: The Control of Bleeding in Operations for Brain Tumors With Description of Silver Clips, Ann. Surg. 54:1, 1911.
47. Ashley, L. B., Brooks, C. D., and Thorstad, M. J.: The Use of Cotton Sutures in Surgery, Harper Hosp. Bull. (Detroit) nos. 3-6, 1941.
48. Preston, D J.: Repair of Abdominal Hernia With Steel Cloth Implant, J. Internat. Coll. Surgeons 10:513, 1952.
49 Chasse, R. L: The Use of Steel Wire, J. Maine M. A. 42:289, 1951.
50. Mayfield, F. H., and Levitch, L. A.: Repair of Cranial Defects With Tantalum, Am. J. Surg 64:319, 1945.
51. Brewer, J. H.: The Use of Tantalum Wire and Foil in Repair of Peripheral Nerves, S. Clin. North America 21:1491, 1943.
52. Fulcher, O. H. L.: Tantalum as a Metallic Implant to Repair Cranial Defects, J. A. M. A. 12:931, 1943.
53. Parrera, M. D.: Reactions in Surgical Wounds to Surgical Gut and Cotton Sutures, Arch. Surg 58:308, 1949.
54. Butler, D. B: Wound Disruption—Questions and Answers, M. Times 81:539, 1953.
55. Mayo, C. W., and Madison, J. L: Separation of Abdominal Wounds, A. M. A. Arch. Surg. 62:882, 1951.
56 Barnes, R M: Motion and Time Study, New York, 1950, John Wiley & Sons, Inc.
57. Manual of Surgical Knots, Somerville, N. J., 1955, Ethicon Suture Laboratories, Inc.
58. Brooks, B., and Duncan, G.: Effect of Pressure on Tissues, Arch. Surg 40.696, 1940.
59 Howe, C W.: Causes of Failure in Antibiotic Therapy, S Clin. North America 39:1351, 1955.

CHAPTER 6

NEUROSURGERY

A clear concept of the form and function of the central nervous system, including its coverings, vascular supply, and cerebrospinal fluid circulation, as well as an understanding of the autonomic and peripheral nervous systems, assists the members of the nursing team in comprehending the significance of the patient's illness and the surgeon's plan of treatment. Only the important basic facts that are directly related to neurosurgical practice are presented. Further information is available by reviewing texts listed as references.

GENERAL ORGANIZATION

The nervous system is divided into two parts: (1) the central nervous system, consisting of the brain and the spinal cord; and (2) the peripheral nervous system, comprising the cranial and spinal nerves and the peripheral portions of the autonomic nervous system. This mechanism, as a whole, is responsible for coordinating body activities in response to both external and internal stimuli.[1-9]

The brain and the spinal cord are so well protected by massive bony and soft tissue structures that their exposure is tedious and time-consuming. Because the clamp and ligature technique for control of hemorrhage is inapplicable to delicate nervous tissue, specialized techniques are necessary to carry out the modern neurosurgical procedures. These techniques will be considered as they relate to specific structures that are encountered during surgery.

The Extracranial Structures

The scalp consists of several layers—the skin, the subcutaneous tissue, and the galea aponeurotica with its occipitofrontalis musculature.[4,6] The skin is thick, and the subcutaneous tissue, which is exceptionally dense, tough, and vascular, is firmly attached to the galea (Figs 140 and 141.) Bleeding of the scalp is best controlled by local pressure, skin clips, or everting the hemostats that are applied to the galea.[5,10] Scalp wounds or incisions are closed by placing interrupted sutures individually in both the galea and the skin (Chapter 5) The subgaleal space contains loose areolar tissue which permits mobility of the scalp and is a favorite site for abscess formation. The deepest layer which covers the cranium is known as the pericranium or outer periosteum of the skull. The surgeon strips this off the skull when turning down a scalp flap in preparation for a craniotomy. The arterial supply of the scalp is derived from the external carotid artery through the superficial temporal, the posterior auricular, and the occipital branches and from the frontal and the supraorbital branches of the ophthalmic

artery (Fig. 147). Most veins roughly follow the course of the arteries, except those few which drain directly into the intracranial venous sinuses via emissary veins. The scalp, the extracranial arteries, and portions of the dura mater are the only pain-sensitive structures that cover the brain, which itself is insensitive. For this reason, a local anesthetic agent is generally sufficient although seldom used for most intracranial operations. Scalp incisions are always planned with these anatomic facts in mind. (Figs. 140, 158, 159, and 163.)

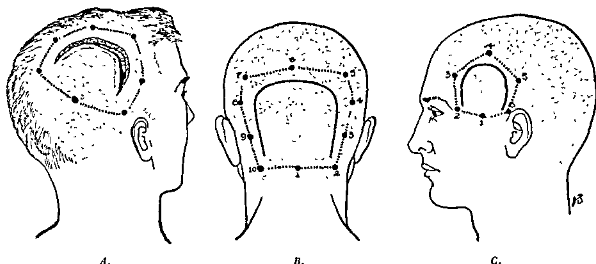


Fig 140.—*A*, Field block incision of the scalp. *B*, Block of the skull and posterior fossa. *C*, Block for temporal bone flap. (From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co)

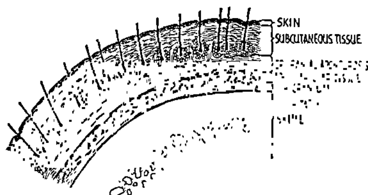


Fig 141 —The scalp is composed of the following layers skin, subcutaneous tissue which contains blood vessels and nerves; aponeurotic layer (galea aponeurotica, epicranial aponeurosis) which is the aponeuorsis of the occipitofrontalis muscle, the loose subaponeurotic layer, and the pericranium The outer three layers are adherent to each other (From Berman, J K: Principles and Practice of Surgery, St Louis, 1950, The C V Mosby Co)

The Skull

The bony structures of the head and face, twenty-four in all, form the skull. These are joined by serrated bony seams called sutures. In the infant, these sutures are not firm and so allow for considerable molding during childbirth.

At the superior angles of the parietal bones are the anterior and posterior fontanels, which are open at birth. In the baby, the subdural spaces or lateral ventricles can be easily reached with an aspirating needle, without making burr holes in the skull. If the suture lines close prematurely the skull cannot expand as the brain grows. This condition, which is called craniosynostosis, demands early opening of the fused sutures.

The skull, which as a whole is oval-shaped, is wider in back than it is in front; it is composed of flattened or irregular bones which consist of two tables of compact substances that enclose a layer of spongy bone, known as dipolë. The sides and roof of the skull are formed by the frontal, parietal, temporal, and occipital bones (Fig. 142)

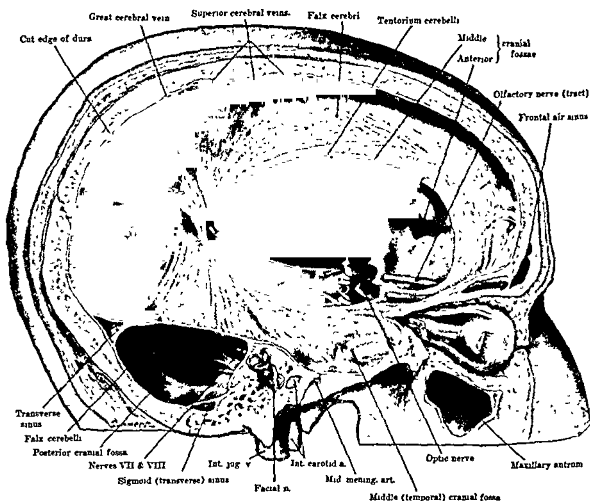


Fig 142 —The intracranial dura mater, showing the falx cerebri, and the tentorium cerebelli fanning out laterally, dividing the posterior cranial fossa from the middle and anterior fossae (From Mettler, F A: Neuroanatomy, St. Louis, 1948, The C V. Mosby Co)

The interior of the skull at its base is anatomically divided into three cranial fossae: anterior, middle, and posterior (Fig. 142). The anterior fossa is limited posteriorly by the sphenoid ridge, along which pituitary tumors and aneurysms of the circle of Willis are generally approached. The frontal lobes and olfactory bulbs and tracts lie in the anterior fossa. The temporal lobes lie in the middle

fossa, which is shaped like a butterfly. The sella turcica, formed by the sphenoid bones, is the most central part of the middle fossa and it houses the pituitary gland. The floor and lateral walls of the middle fossa are shaped from the greater wing of the sphenoid bone and parts of the temporal bone. The posterior fossa, which is the largest and deepest fossa, is formed by the occipital, sphenoid, and petrous portions of the temporal bones, and the cerebellum, pons, and medulla lie here, along with many of the cranial nerves. The foramen magnum (Fig. 143), which is the largest opening in the skull and the most prominent anatomic feature of the posterior fossa, transmits the brain stem as it joins the spinal cord. There are numerous other openings in the base of the skull for passage of arteries, veins, and cranial nerves.

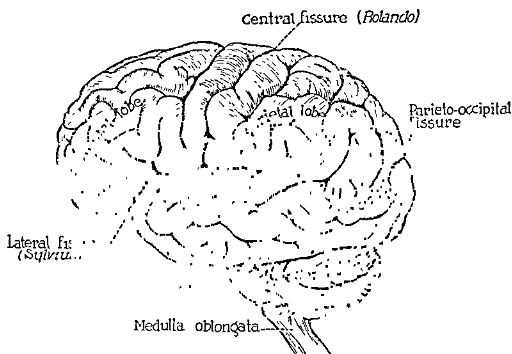


Fig. 143—Lateral view of cerebral hemisphere (showing lobes and principal fissures), cerebellum, pons, and medulla oblongata. (From de Gutiérrez-Mahoney, C. G., and Carini, E.: Neurological and Neurosurgical Nursing, St. Louis, 1956, The C. V. Mosby Co.)

The Meninges

Lying between the skull and brain are the meninges, which comprise three covering membranes known as the dura mater, arachnoid, and pia mater, respectively (Fig. 144).

The dura mater is a tough, shiny, fibrous membrane which is closely applied to the inner surface of the skull, and which, by several folds, separates the cranial cavity into adjoining compartments. The largest fold is the falx cerebri, which is an arch-shaped, vertically placed, midline structure that separates the right and left cerebral hemispheres from each other (Figs. 142 and 144). A smaller fold of dura, known as the falx cerebelli, separates the cerebellar hemispheres vertically. Another fold, which is transversely situated, known as the tentorium cerebelli, forms the roof of the posterior fossa, on which rest the occiptal lobes

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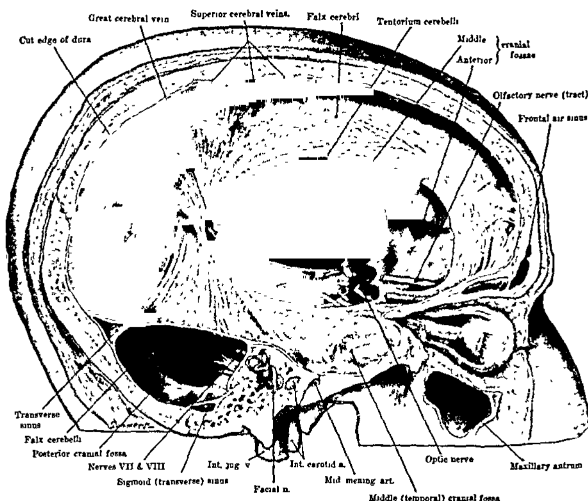


Fig 142 —The intracranial dura mater, showing the falx cerebri, and the tentorium cerebelli fanning out laterally, dividing the posterior cranial fossa from the middle and anterior fossae (From Mettler, F. A. Neuroanatomy, St Louis, 1948, The C V Mosby Co)

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The pia mater, the innermost membrane, is gossamer-like and covers the brain intimately, dipping deep into each of the sulci (Fig. 144). Directly below the pia mater is a rich, superficial vascular network.

Gross Anatomy of the Central Nervous System

The anatomy of the central nervous system is complex, and even today not all of the finer points have been fully elucidated.[1, 5, 11-14] The professional nurse should have an understanding of certain aspects of the gross anatomy.

There are two cerebral hemispheres, right and left, each controlling motor activity and receiving sensory stimuli from the opposite half of the body. They are joined underneath the falx by a huge transverse bundle of nerve fibers known as the corpus callosum. The surfaces of the hemispheres are thrown into folds which are called gyri or convolutions; between these gyri lie the fissures or sulci of the brain (Fig. 143). The two sulci of great anatomic importance to the surgeon

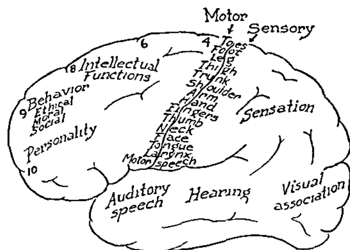


Fig. 145.—Principal functional subdivisions of the cerebral hemispheres Note numbered areas (Brodmann) generally used to designate specific anatomic and physiologic components (From de Gutiérrez-Mahoney, C G, and Carini, E Neurological and Neurosurgical Nursing, St. Louis, 1956, The C V Mosby Co)

are the central sulcus of Rolando, which separates the motor from the sensory cortex, and the fissure of Sylvius, which marks off the temporal lobe. That part of the hemisphere which is anterior to the fissure of Rolando is the frontal lobe. To a considerable degree, it controls the higher functions of intellect and abstract reasoning. Within the frontal lobe, just in front of the Rolandic fissure, is the motor cortex which, if destroyed, leads to loss of voluntary motor function on the opposite side (Fig. 145) of the body (hemiplegia). Behind the central sulcus is the parietal lobe, extending back to the parieto-occipital fissure. This area contains the final receiving and integrating station for sensory impulses from the contralateral side of the body. Most posteriorly is the occipital lobe whose function is to receive and integrate visual impulses and register them as meaningful images. Inferior to the fissure of Sylvius, in the middle fossa of the skull, lies the temporal lobe. Lesions of the left temporal lobe in right-handed individuals

of the cerebral hemispheres. Below the tentorium lie the cerebellum and brain stem (Fig. 144).

At the margins of these dural folds lie large venous sinuses which drain blood from the intracranial structures into the juglar veins. Several arteries also lie within the layers of the dura, the largest of which, the *middle meningeal*, may give rise to serious hemorrhage if it is torn by an overlying fracture of the skull.

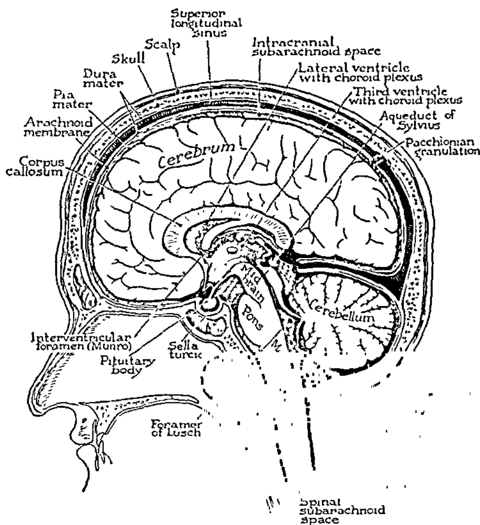


Fig 144 —Diagram of sagittal section of the head, showing cerebrospinal fluid spaces and their relationship to the venous coverings (From de Gutiérrez-Mahoney, C. G , and Carini, E · Neurological and Neurosurgical Nursing, St Louis, 1956, The C. V. Mosby Co)

Beneath the dura mater is a fine membrane, the arachnoid, which consists of two layers. The outer layer closely approximates the dura, and the inner layer is made up of innumerable spidery filaments that give it a spongy texture.[1, 4, 7] The inner layer, or subarachnoid space, is filled with cerebrospinal fluid, which constantly bathes the brain. In places, particularly around the base of the brain, this space becomes enlarged to form cisterns that connect with the ventricular system. Its function is more fully described in connection with the cerebrospinal fluid pathways.

VENTRICLES OF THE BRAIN AND CEREBROSPINAL FLUID CIRCULATION

Anatomic and Physiologic Functions.—Within the substance of the brain are four communicating cavities, called ventricles, that are filled with cerebrospinal fluid.[7] In the lower medial portion of each cerebral hemisphere lies the large lateral ventricle which resembles a wishbone and is separated from its mate on the opposite side by a thin layer, the septum pellucidum (Fig. 146). Each lateral ventricle consists of a body and three horns, frontal, occipital, and temporal. Below the bodies of the lateral ventricles is a centrally placed cleft, designated as the third ventricle. It communicates anteriorly with the lateral ventricles through the foramina of Monro and posteriorly with the fourth ventricle through the aqueduct of Sylvius, a long narrow channel passing through the midbrain. The fourth ventricle is a rhomboid-shaped cavity in the posterior fossa, between the cerebellum and the brain stem. In the roof of the fourth ventricle is an opening into the cisterna magna, known as the foramen of Magendie; at the lateral margins are the two foramina of Luschka (Fig. 144).

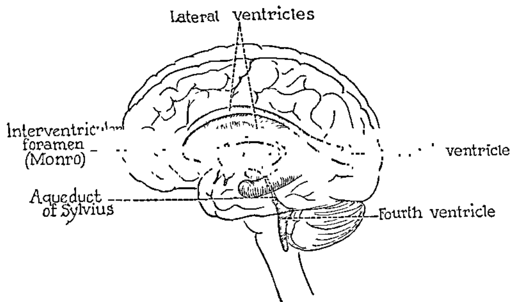


Fig 146.—Diagram of the ventricular system, showing its relationship to the various parts of the brain. (From de Gutiérrez-Mahoney, C G, and Carini, E: Neurological and Neurosurgical Nursing, St Louis, 1956, The C V. Mosby Co)

Most of the cerebrospinal fluid originates in the choroid plexuses of the ventricles. These are tufted, vascular structures, not unlike the glomerulus of the kidney, which allow certain fluid elements of the blood to pass through their ependymal linings. A choroid plexus is found in each lateral ventricle along its floor, on the roof of the third ventricle, and in the posterior portion of the fourth ventricle. Most of the fluid is elaborated in the lateral ventricles, from whence it flows through the interventricular foramina of Monro to the third ventricle. From there it traverses the aqueduct of Sylvius to gain access to the fourth ventricle, and from there it escapes into the subarachnoid space of the basal cisterns

often affect the comprehension and the verbalization of words; the result is aphasia. This is one reason why it is important to the neurosurgeon to know whether a patient is right- or left-handed.

The cerebral hemispheres are covered by a layer of gray matter, the cerebral cortex, which contains the cell bodies of the many nerve pathways of the brain. The underlying white matter consists of millions of myelinated nerve axons and is relatively avascular as compared to the cortex. The nerve pathways are of three main types: (1) the transverse or commissural fibers, which pass from one cerebral hemisphere to the other, (2) the association fibers, which extend longitudinally from one cortical or subcortical region to another, and (3) the projection fibers of the great motor and sensory system.[8, 9, 14, 15]

In a lobotomy the association fibers from the frontal lobe are divided, thus effecting changes in personality of the individual, which may be of benefit in combatting certain psychiatric disorders.

Deep in the brain are several important large cell stations which are not frequently exposed in neurosurgical procedures, but whose function is well understood. For example, the basal ganglia are collections of nuclei of the extrapyramidal system that are concerned with the smoothing out of motor activities, and lesions here cause rigidity of the skeletal muscles and various types of spontaneous tremor, such as seen in Parkinson's disease or in St. Vitus' dance. Lateral to the third ventricle is the thalamus, the great receiving station of incoming sensory stimuli on the way to their final destination in the parietal cortex. Along the floor of the third ventricle is the hypothalamus, which is principally concerned with the autonomic regulation of the body's internal environment and which is intimately connected with the pituitary gland.

The short, stocky portion of the brain, between the cerebral hemispheres and pons, is called the midbrain (Fig. 144). It is made up of the cerebral peduncles and numerous other nerve tracts and contains the nuclei and association centers which control the majority of eye movements. The hindbrain, or so-called brain stem, which is immediately below the midbrain consists of the pons and medulla oblongata. These form the floor of the fourth ventricle in the posterior fossa of the skull and contain many large efferent and afferent tracts besides nuclei of most cranial nerves (Fig. 148). Since so many vital structures are crowded together in this region, direct surgery is fraught with great danger.

The cerebellum (Fig. 144), which occupies most of the posterior fossa, forms the roof of the fourth ventricle Grossly, it has two lateral lobes and a medial portion called the vermis. The fissures of the cerebellum are small and run transversely, giving it a laminated appearance. The cerebellum is principally concerned with balance and coordination of movement It has many complex connections with higher and lower centers, and it exerts its influence homolaterally in contrast to the cerebral hemispheres which act contralaterally. The majority of brain tumors in children originate in the cerebellum; in adults, the commonest surgical lesions are tumors, abscesses, and various inflammatory lesions of the meninges. By splitting the vermis in the exact midline, a satisfactory exposure of tumors which lie in the fourth ventricle is obtained without sacrificing the important cerebellar functions.

lows the surgeon to both diagnose and localize tumors and other space-occupying lesions of the brain, to diagnose loss of brain substance from various causes, and to demonstrate congenital malformations.

Air is commonly used as the contrast medium; it can be injected directly into the ventricles (ventriculography) or may be introduced in the spinal subarachnoid space, whence it rises to fill the ventricles and the cranial subarachnoid systems (encephalography). A ventricular puncture in infants is performed through the lateral border of the open anterior fontanel, whereas in adults the burr holes are usually placed in the posterior parietal region for this purpose (Figs. 143 and 157).

When a tumor is suspected, especially when the patient has increased intracranial pressure, the ventricular route is mandatory. Dangerous temporal lobe or brain-stem herniation, with sudden death, may follow a spinal puncture in those patients with an increased pressure. Because air is somewhat irritating, it tends to increase the pressure even when it is carefully injected directly into the ventricles. Prompt craniotomy must follow the disclosure of an intracranial tumor, and, occasionally, great speed is necessary to prevent a catastrophe when the pressure is very high and there is a large shift of the ventricular system.

The routine x-rays are best taken in the operating room if a satisfactory machine is available. Otherwise the patient must be transported to the x-ray department to obtain films of diagnostic value. Air studies are frequently supplemented by percutaneous carotid arteriography for additional localization and definition of a space-occupying lesion.

VASCULAR SUPPLY OF THE BRAIN

The arterial supply of the brain is derived from the internal carotid arteries anteriorly and the vertebral arteries which join to form the basilar arteries posteriorly. Communications between these make up the arterial circle of Willis which is situated at the base of the brain. The branches of the circle are of two types: (1) the small central terminal arteries which dip perpendicularly into the brain and do not anastomose with one another, and (2) the three large cortical branches on either side, named, respectively, the anterior, middle, and posterior cerebral arteries. The latter have a fairly free communication with each other peripherally, so that occlusion of one may be partly compensated by its neighbor. They do not, however, anastomose with their mates of the opposite hemisphere except through the inefficient communicating branches of the circle of Willis. (Figs 144 and 147.)

The cerebral veins do not parallel the arteries as do the veins in most other parts of the body. The external cortical veins anastomose freely in the pia mater, forming larger cerebral veins, and as such they pierce the arachnoid space, cross the subdural space, and empty into the great dural venous sinuses which have been described in conjunction with the meninges (Fig. 147). A subdural hemorrhage which occurs following head trauma comes from these bridging vessels, whereas extradural hemorrhage results from lacerations of the middle meningeal artery, a branch of the external carotid artery that supplies the dura mater. The

via the foramina of Magendie and Luschka. From the basal cisterns the fluid is directed down around the spinal cord, up over the cerebellar lobes or around the medulla, the base of the brain, and over the cerebral hemispheres in the cranial subarachnoid space. The fluid returns to the blood stream, by osmosis, through little projections of the arachnoid (pacchionian granulations) into the great dural venous sinuses, particularly along the superior sagittal sinus, and by diffusion through perivascular, perineural and periradicular channels.

The total content of circulating cerebrospinal fluid averages 125 to 150 ml. in the adult. Each lateral ventricle contains 10 to 15 ml., the rest of the ventricular system contains 5 ml., the cranial subarachnoid space averages about 25 ml., while the spinal subarachnoid space contains about 75 ml. The ventricular fluid normally has 5 to 15 mg. per cent protein content, whereas the spinal fluid values are 25 to 45 mg. per cent. These may be considerably elevated in various lesions of the central nervous system.

The function of the cerebrospinal fluid is mainly mechanical. It bathes the brain and spinal cord, helps support the weight of the brain, and acts as a cushion for it and the spinal cord, thus absorbing some of the force of external trauma. By variation in its volume it aids in keeping intracranial pressure relatively constant. If there is atrophy of the brain, it increases in amount to take up the dead space; if the brain swells due to trauma or a tumor, thus increasing the intracranial contents, the cerebrospinal fluid becomes less in amount. The fluid removes waste products of nervous tissue metabolism, and it is useful in carrying certain drugs to injured parts of the body. It, however, does not play a significant role in supplying nutrition to the structures that it bathes.

The rate of formation and absorption of cerebrospinal fluid is related to the osmotic and hydrostatic pressure of the blood. Frequently, some use is made of this fact. In instances of increased intracranial pressure, an intravenous injection of hypertonic glucose or a rectal instillation of 25 per cent magnesium sulfate is employed to dehydrate the blood and thus draw off the cerebrospinal fluid

Cerebrospinal fluid pressure may be elevated for a number of reasons: (1) an expanding mass lesion within the skull, such as a tumor, hemorrhage, or cerebral edema; (2) an increased formation of fluid, as in meningitis, encephalitis, and other febrile conditions; (3) an increase in venous pressure within the skull from an obstruction to normal venous drainage; (4) a blockage of absorption by inflammatory conditions of the arachnoid and perivascular spaces; (5) any mechanical obstruction of the ventricular or subarachnoid fluid pathways.

The neurosurgeon is vitally interested in the cerebrospinal fluid pressure, as many of the lesions which cause an increased pressure may be treated by modern neurosurgery.

Examination of the Ventricular System.—Visualization of the ventricular system by ventriculography or encephalography as introduced by Dandy is the most useful diagnostic tool in neurosurgery.[9, 16-18] By means of this technique, deviations from the normal size, shape, and position of the ventricles may be roentgenographically observed. The information obtained by such studies al-

bone. This nerve carries the sense of smell. Frontal lobe tumors, fractures of the anterior fossa of the skull, and lesions of the nasal cavity frequently affect the olfactory nerve.

Cranial Nerve II.—The optic nerve is also a fiber tract of the brain structurally. It originates in the ganglion cells of the retina and passes through the optic foramen in the apex of the orbit to reach the optic chiasm, where a partial crossing of the fibers occurs, so that those fibers from the nasal half of each retina pass to the opposite side. Posterior to the chiasm the visual pathway is called the optic tract, and still further back to the occipital lobe it becomes the optic radiation. Lesions in various parts of this pathway produce characteristic defects in the visual fields. For example, a lesion of the chiasm usually destroys the temporal vision of each eye (bitemporal hemanopsia), whereas a lesion of the occipital lobe will produce impairment of vision to the opposite side in both eyes (homonymous hemanopsia).

The lesions which affect the optic nerve and which are treated by neurosurgery include primary gliomas of the nerve, pituitary tumors which press upon the optic chiasm, and occasionally meningiomas in the region of the sella turcica and olfactory groove. The optic nerves and chiasm are best exposed through a frontal craniotomy, along the floor of the anterior fossa, or through a frontotemporal approach along the sphenoid ridge.

In malignant exophthalmos, associated with hyperthyroidism, it is sometimes necessary to unroof the orbit and decompress its edematous contents to preserve vision. The widest decompression can be performed by an intracranial, extradural operation. This approach is also useful in exposing the occasional intraorbital tumors that are situated far posteriorly near the apex.

Cranial Nerves III, IV, and VI.—These three pairs of nerves are conveniently considered together as they are the motor nerves to the muscles of the eye. They are, respectively, the oculomotor, the trochlear, and the abducens. They are affected by many toxic, inflammatory, vascular, or neoplastic lesions, but they have no primary diseases that are treated by neurosurgery.

Cranial Nerve V.—The trigeminal nerve has two functions: (1) the sensory supply of the forehead, eyes, meninges, face, jaw, teeth, hard palate, buccal mucosa, and tongue; and (2) the motor innervation of the muscles of mastication. The sensory fibers which arise from cells in the gasserian ganglion travel along the medial wall of the middle cranial fossa and then extend peripherally in three divisions, ophthalmic, maxillary, and mandibular. Behind the ganglion, the fibers enter the brain stem via the sensory root. The motor root, which originates from cells in the brain stem, follows the course of the larger sensory component.

The trigeminal nerve is the site of a distressing neuralgia, tic douloureux, which is characterized by excruciating, piercing pains of brief duration affecting one or more of the major peripheral divisions. The recurrent attacks are usually brought on by stimulation of trigger zones present about the face, nares, lips, or teeth. This affliction, which is of unknown etiology, occurs unilaterally and mainly in older persons. Medical treatment is generally unsuccessful, and a great variety of neurosurgical procedures have been proposed for its control. Periph-

deep cerebral veins which drain the interior of the hemispheres empty principally into the great vein of Galen and the inferior sagittal sinus.

The arterial supply of the brain may be outlined roentgenographically by injecting a radiopaque substance into the carotid or vertebral arteries and exposing x-ray films as the material courses through the system.[16] This technique, which is called cerebral angiography or arteriography, is a valuable aid in revealing intracranial aneurysms and in demonstrating the specific displacement or pathologic changes of vessels which occur with tumor growths and other intracranial mass lesions. In recent years arteriography has become one of the neurosurgeon's most helpful diagnostic tools.

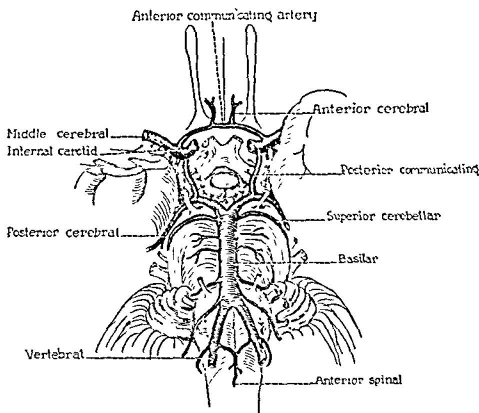


Fig. 147.—Diagram of the principal cerebral arteries and the circle of Willis (From de Gutiérrez Mahoney, C. G., and Carini, E.: Neurological and Neurosurgical Nursing, St. Louis, 1956, The C. V. Mosby Co.)

The venous sinuses may be similarly studied by injecting a radiopaque substance into the superior longitudinal sinus through a previously placed burr hole (dural sinus venography) and taking appropriate films. Blockage by a tumor or an occlusion by thrombosis can thereby be demonstrated.

THE CRANIAL NERVES

There are twelve pairs of cranial nerves, several of which are of considerable neurosurgical importance. It is appropriate to consider their anatomy, function, and surgery together.

Cranial Nerve I.—The olfactory nerve, which actually is a fiber tract of the brain, is located under the frontal lobe on the cribriform plate of the ethmoid

and pons and manifests its presence by unilateral deafness, tinnitus, unilateral impairment of cerebellar function, occasionally numbness of the face from involvement of the fifth cranial nerve, and, late in the course, by pressure on the pons and papilledema. The operative approach is usually via a unilateral suboccipital craniotomy, similar to but somewhat wider than that described under the posterior approach to the fifth nerve. Great care must be taken to avoid injury to the pons, and an attempt is made to preserve the facial nerve, if possible. Surgeons vary in their preference for placing the patient in a sitting, prone, or lateral decubitus position.

The syndrome, known as Meniere's disease, is an eighth nerve affliction characterized by deafness and tinnitus with episodic attacks of severe vertigo and vomiting. These episodes may pitch the patient violently to the floor without warning and even commit him to bed for days at a time. When simple medical measures fail to alleviate the problem, section of the eighth nerve intracranially is performed with consistently excellent results.

Cranial Nerve IX.—The glossopharyngeal nerve supplies taste to the posterior one third of the tongue and sensation to the tonsils and pharyngeal region and partially innervates the pharyngeal muscles. Rarely it is involved in a painful tic similar to trigeminal tic. There may be occasion to section its sensory component for this reason, to treat a hypersensitive carotid sinus, or, along with the fifth nerve to treat painful malignancies of the face, mouth, and pharynx.[13, 14, 19] It lies near the eighth nerve in the posterior fossa and is exposed in a similar fashion.

Cranial Nerve X.—The vagus nerve has many functions, chief among which are innervation of pharyngeal and laryngeal musculature, control of heart rate, and acid secretion of the stomach. In neck surgery the surgeon carefully avoids the recurrent laryngeal branch; in gastric surgery he severs the nerve at the lower end of the esophagus to treat a peptic ulcer. The neurosurgeon is mainly concerned with avoiding damage to the vagus nerve during posterior fossa surgery.

Cranial Nerve XI.—The spinal accessory is a motor nerve to the sternomastoid and trapezius muscles. To restore mobility to the face, it may be anastomosed to the peripheral end of a damaged facial nerve.

Cranial Nerve XII.—The hypoglossal nerve innervates the musculature of the tongue Its neurosurgical interest is similar to that of the spinal accessory nerve.

BRAIN TUMORS

Of the brain lesions which are treated surgically, tumors are of great importance. They are not as rare nor is their prognosis as poor as the layman is often wont to believe. If the diagnosis is made early, the surgical treatment may be greatly simplified, because increased intracranial pressure and severe neurologic changes are not usually present.

Brain tumors may be considered malignant or benign, depending on the cell type However, they are usually classified into four major groups:

1. The glioma, which is a true primary tumor of the brain tissue, accounts for 55 per cent of all brain tumors Some gliomas, especially the glioblastoma

eral neurectomies of the supraorbital or infraorbital nerves may easily be performed under local anesthesia in appropriate cases, but the effect is temporary since the nerves regenerate.[10, 11] The most certain method of relief is retrogasserian neurectomy. When the nerve root is divided behind the ganglion, no regeneration can occur, and the pain is permanently obliterated. However, some patients complain about the postoperative numbness of the face and a few are disturbed by annoying paraesthesia. Anesthesia of the cornea may rarely lead to serious keratitis. In recent years differential section of the root has been so perfected as to preserve a few sensory fibers to the cornea and obviate this complication in patients where the pain does not involve the eye; furthermore in most cases the motor root usually can be saved.

Retrogasserian neurectomy may be performed through a temporal approach along the floor of the middle fossa or via a posterior fossa exposure, in which case the nerve root is sectioned in the cerebellopontine angle at its emergence from the pons. The temporal operation is carried out with the patient in a sitting or supine position, depending upon the preference of the surgeon. The procedure is decribed later under Subtemporal Decompression.

The posterior approach is similar to that used for division of the eighth and ninth cranial nerves. A laterally placed vertical or curved incision, adjacent to the mastoid process, is made and a hole ronguered in the bone between the angle of the transverse and lateral sinsuses. The dura mater is opened and the cerebrospinal fluid aspirated from the cisterna magna. The cerebellum is then retracted medially to expose the cerebellopontine angle where the fifth, seventh, eighth, ninth, and tenth nerves are visualized. Usually a large petrosal vein must be divided before the trigeminal nerve can be sectioned. The wound is closed tightly with silk sutures without drainage.

By the posterior fossa approach the surgeon can more easily spare the motor root, but this feature is countered by the slightly greater morbidity as compared to the temporal operation.

Cranial Nerve VII.—The facial nerve supplies the musculature of the face and taste to the anterior two thirds of the tongue. It originates in the brain stem, passes through the skull with the eighth nerve via the internal acoustic meatus, along the facial canal, and exits just posterior to the parotid gland. The nerve may be damaged by acoustic neurinomas, fractures at the base of the skull, mastoid infections, or by surgical procedures in the vicinity of the parotid. When permanent interruption occurs, useful operations for restoration of function include spinofacial or hypoglossofacial anastomosis (cranial nerves XI to VII, cranial nerves XII to VII, respectively). These operations are performed high in the neck behind the parotid gland.[10]

Cranial Nerve VIII.—The acoustic nerve has two parts, both sensory, the cochlear for hearing and the vestibular for balance The former receives stimuli from the organ of Corti, the latter from the semicircular canals of the inner ear. The major surgical lesion of the eighth nerve is the acoustic neurinoma which is a benign tumor growing from the nerve sheath at its entrance into the internal auditory meatus. This tumor arises deep in the angle between the cerebellum

no evidence of increased pressure, a study of the cerebrospinal fluid. In recent years various radioactive isotope techniques have shown promise in accurately localizing tumors of the cerebral hemispheres.

Finally, the visualization of the position of the cerebral ventricles by ventriculography indicates the exact position of the tumor for the neurosurgeon's attack. In the case of cerebral tumors, this is by osteoplastic craniotomy. Posterior fossa neoplasms are exposed by one of the suboccipital procedures.

THE SPINAL COLUMN AND CORD

The spinal column consists of thirty-three vertebras, seven cervical, twelve thoracic, five lumbar, five sacral (fused as one), and one coccygeal, a fusion of four small vertebras (Fig. 148).

The first cervical vertebra, or atlas, serves as a support for the skull and is distinguished by its absence of a body and spinous process. The axis, or second cervical vertebra, is notable for its odontoid process, a vertical projection extending into the spinal canal of the atlas like a stick in a hoop. Strong ligaments hold the two together but allow for considerable rotational movement. When these ligaments are torn, as in a hanging, or the odontoid is fractured by trauma, the atlas may slip on the axis and crush the cord, resulting in immediate death.

The remainder of the cervical, thoracic, and lumbar vertebras have certain important anatomic points in common. Each has a body which is an oval block of spongy bone situated anteriorly and is separated from its mate by an intervertebral disc, a fibrocartilaginous elastic cushion (Fig. 149). Just posterior to the body in the midline lies the spinal cord in its canal (Fig. 149). This canal is formed by the body anteriorly, the pedicles laterally, and the laminas posteriorly, making up a complete arch (Fig. 149). Articular surfaces projecting from the pedicles are called facets and form joints with the facets of the vertebras above and below. Extending laterally from the arch are the transverse processes, which serve as hitching posts for muscles and ligaments. Posteriorly, the arch gives off a spinous process which may be palpated in all but the excessively obese (Fig 150). The vertebras are held together by multiple ligaments and muscles. Motion of the spine occurs at the articular facets and through the elastic intervertebral discs.

The spinal cord is thus enclosed in a heavy protective framework. The dura is not firmly attached to its bony surroundings as the cranial dura is to the skull, but is buffered with a layer of epidural fat. Beneath the dura mater is the arachnoid which is a continuation of the same structure within the cranium. The subarachnoid space contains spinal fluid, and a thin layer of pia mater intimately covers the cord.

The spinal cord is a downward prolongation of the brain stem, starting at the upper border of the atlas and ending at the upper border of the second lumbar vertebra. The cord is oval in cross-section, being slightly flattened in the anteroposterior diameter. A cross-section looks like a gray letter H surrounded by a white mantel split in the midline anteriorly and posteriorly by sulci.

multiforme, are highly invasive and usually incurable. In many instances, complete surgical removal of the tumor renders palliation and comfort to the patient. Other less active gliomas may be permanently cured by wide excision.

2. The meningiomas and neurinomas which arise from fibrous structures make up about 25 per cent of all tumors. These lesions are generally benign, and when totally removed, they do not recur. However, they may attain such a large size or may be located in such an unfavorable situation that a total surgical extirpation cannot be performed.

3. The glandular tumors are principally pituitary neoplasms.

4. The miscellaneous group of metastatic tumors, vascular tumors, craniopharyngiomas, dermoids, teratomas, cholesteatomas, colloid cysts, and papillomas of the choroid plexus are less commonly found.

At least 50 per cent of brain tumors are benign and amenable to surgery.

A brain tumor is diagnosed by first recognizing the early symptoms and their subsequent evolution and then applying certain tests for more accurate localization. The neurosurgeon's diagnostic ability depends on a thorough knowledge of neuroanatomy and neurophysiology plus an understanding of the behavior of various kinds of brain tumors. The manifestations of an intracranial tumor fall in two classes: those resulting from increased intracranial pressure and those resulting from impairment or irritation of function of specific areas of the brain.

For example, lesions which are situated in the left frontotemporal region where motor speech originates lead to aphasia, occipital tumors produce hemianopic visual defects, and large frontal lobe tumors may cause striking personality changes. Cortical tumors frequently produce focal seizures of diagnostic value. The onset of epileptiform seizures in the adult is often associated with an intracranial neoplasm Pituitary tumors characteristically press on the optic chiasm and so impair temporal vision. They disturb pituitary glandular function, resulting in hypopituitary states, pituitary dwarfism, or acromegaly, as the case may be. The posterior fossa tumors more often manifest their presence by blocking the cerebrospinal fluid circulation, but they may also destroy cerebellar function, resulting in incoordination, ataxia, and scanning speech.

The commonest symptom of increased intracranial pressure is headache, but it does not always accompany increased pressure. The characteristics and location of the pain may vary and are seldom of specific diagnostic value. Vomiting is also a frequent sign of increased pressure and usually it is not associated with nausea. This is particularly true of tumors in the posterior fossa in children. Chronic increased pressure causes papilledema and not infrequently diplopia due to a sixth nerve palsy. Eventually, mental dullness, unconsciousness, and coma occur. More acute rises in pressure produce respiratory irregularities, slowing of the pulse, and elevation of blood pressure

A careful historic account of the patient's march of symptoms and a thorough neurologic evaluation are the most important aspects of diagnosis. Special methods of examination are also necessary in most instances; these include x-rays of the skull, electroencephalography, cerebral angiography, and, when there is

no evidence of increased pressure, a study of the cerebrospinal fluid. In recent years various radioactive isotope techniques have shown promise in accurately localizing tumors of the cerebral hemispheres.

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The peripheral white matter carries the long myelinated motor and sensory tracts, while the central gray matter consists of nerve cell bodies and short unmyelinated fibers (Fig. 148). The principal long pathways are the laterally placed pyramidal tracts carrying impulses down from the cerebral cortex to the motor neurons of the cord, the dorsal ascending columns mediating sensations of touch and proprioception, and the anterolaterally placed spinothalamic tracts carrying pain and temperature sensation to the thalamus, the great sensory receiving station of the brain.[7, 14, 15]

At each vertebral level a pair of spinal nerves emerges from the cord. Each is formed by two roots, an anterior or motor root, whose cells lie in the anterior horn of the spinal gray matter, and a posterior root, whose cell bodies lie in the spinal ganglia in the intervertebral foramina through which the nerves exit from the spinal canal (Fig. 148). The cervical nerves pass out horizontally, but at each lower level they take on an increasingly oblique and downward direction. In the lumbar region the course of the nerves is nearly vertical, and they form the cauda equina. This phenomenon is explained by the fact that the spinal cord, which fills the entire spinal canal in the fetus, grows at a slower rate than the bony spine, thus leaving the lower nerves a progressively longer course to their exit.

In the cervical and lumbosacral regions the spinal nerves regroup in a plexiform manner before they terminate as the peripheral nerves of the upper and lower extremities, respectively, whereas those in the thoracic region become the intercostal nerves. The principal nerves of the upper or brachial plexus are the musculocutaneous, median, ulnar, and radial, and those of the lumbosacral plexus, the obturator, femoral, and sciatic. Their branches and specific functions are detailed in anatomic texts and works on peripheral nerve surgery.[7, 8, 17]

Surgery of the Spinal Cord and Its Adjacent Structures.—Operations are directed toward the following conditions: congenital malformations, injuries, tumors, herniated intervertebral discs, infections, and various operative procedures for the relief of intractable pain.

The commonest congenital lesion encountered is a *meningocele or meningomyelocele* of the lumbar region due to failure of union of the vertebral arches in intrauterine life.[20] This appears to be a fluid-filled, thin-walled sac which often contains neural elements. Surgical correction is necessary when the sac lining is precariously thin or there is a cerebrospinal fluid leak. The operation consists

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Fig 148.—Posterior view of the brain stem and spinal cord *A*, A torso (His-Steger cast), dissected from the back, is shown The dura has been opened and the cord exposed The levels concerned can be easily determined by referring to the ribs on the left side of the thorax The cord proper terminates opposite the body of the second vertebra (see *B*) as the conus medullaris. *B*, The ventral surface of a cord stripped of the dura and arachnoid It is a symmetrical structure, the two halves of which are separated by the ventral fissure This fissure stops at the level of the foramen magnum Caudally, the pia leaves the conus medullaris as a round, thin, glistening thread, the filum terminale *C*, The cord is exposed from the lateral side. The dura has been opened Since the cord is shorter than the canal that contains it and since the spinal nerves leave through the intervertebral foramina, one at a time, the lowest portion of the vertebral canal is occupied not by cord but by a bundlelike accumulation of nerve roots, the cauda equina The caudal end of the dural sac, which encloses the spinal cord and cauda equina, lies somewhere between the level of the middle of the bodies of the first and third sacral vertebras The size and position of the three views correspond and the delimitation of the major vertebral levels is indicated by transverse lines for all three figures. (From Mettler, F. A.: Neuroanatomy, St Louis, 1948, The C V Mosby Co)

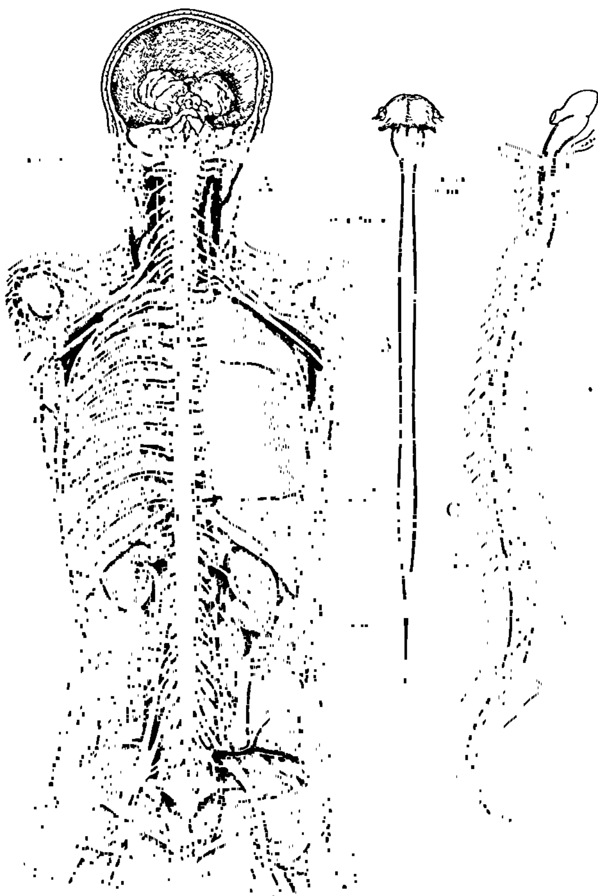


Fig. 118.—For legend, see opposite page.

internal secretion, and peripheral involuntary muscles are innervated (Fig. 151). The major anatomic difference between the somatic and autonomic nervous systems is that in the former an impulse from brain stem or spinal cord reaches the end organ via a single neuron, while in the latter it traverses two neurons, the *first ending in an autonomic ganglion, the second running from the ganglion to* the end organ. Some of these ganglia lie along the side of the vertebral column to form the sympathetic trunks or chains, while others are closely associated with the end organs.

The preganglionic neurons from the brain stem, which go out along the cranial nerves and those from the second, third, and fourth sacral segments to the pelvic viscera, end in ganglia in proximity to their end organs; thus their postganglionic fibers are very short. This is known as the parasympathetic or craniosacral division of the autonomic nervous system. The preganglionic fibers from the thoracic and lumbar spinal cord end in the paravertebral ganglia, making up the sympathetic chain, and their postganglionic fibers are relatively long. This is termed the sympathetic or thoracolumbar division of the autonomic nervous system.

The two divisions are distinct anatomically and physiologically. The chemical substance mediating transmission of impulses at most sympathetic nerve endings is similar to adrenaline, which is called sympathin, and that at most parasympathetic endings is similar to acetylcholine and called parasympathin.

The majority of organs have a dual innervation, part from the craniosacral and part from the thoracolumbar divisions. The functions of these two systems are antagonistic. Together they preserve our body homeostasis, or milieu interior, as Claude Bernard, in 1878, called it. In general, the thoracolumbar division functions as an emergency protective mechanism always ready to liberate an extraordinary amount of body energy to combat any variety of stressful or adverse circumstance. The craniosacral division functions to conserve energy in periods of rest by slowing the heart rate.

Stimuli arising from internal organs or from the outside traverse visceral and somatic afferent nerve fibers which make reflex connections with preganglionic autonomic neurons in the brain stem and spinal cord, and thereby call these involuntary systems automatically into appropriate activity. When these automatic mechanisms break down or overact, surgery may be indicated. For example, a thoracolumbar sympathectomy is performed in hypertension in order to lower blood vessel tone and, therefore, the blood pressure, or vagotomy is done to decrease acid secretion of the stomach in peptic ulcer patients, while lumbar sympathectomy is used to relieve vasospastic disorders of the legs. Herein lies the basis for the various forms of surgical sympathectomy.

ANESTHETIC AGENTS FOR NEUROSURGERY

To perform any neurosurgical procedure, the anesthetic is an indispensible adjunct. The members of the nursing staff should know the dangers that may arise when certain anesthetic agents are administered by either a closed or open system or injected locally. They should be aware of the general precautions that

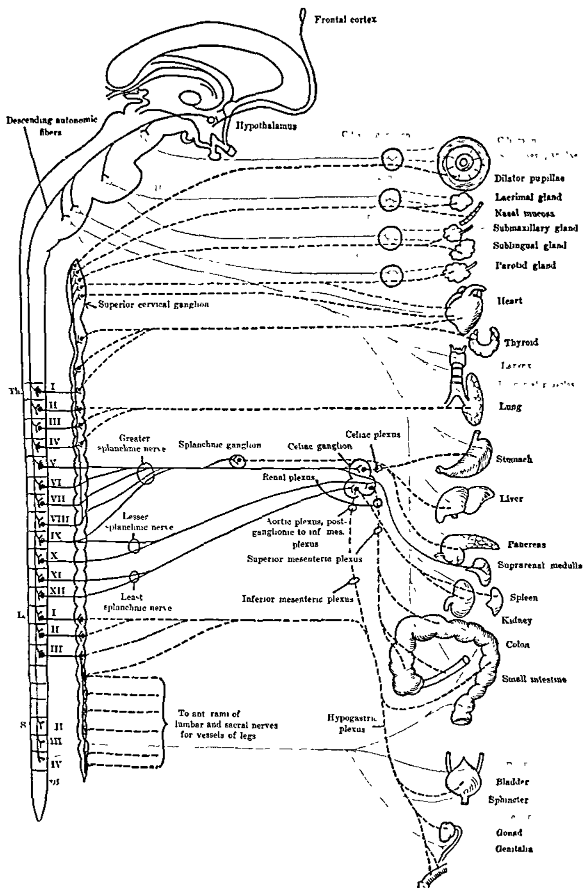


Fig 151 —Diagram of the autonomic nervous system (From Mettler, F A · Neuroanatomy, St Louis 1918, The C V. Mosby Co)

must be enforced to safeguard the patient and personnel from explosive hazards. (Chapter 2.)

When a local anesthetic is to be used, the nurse has the requested drug ready and she records on the patient's chart the total dose of anesthetic administered. Local anesthesia may be used for both intracranial and spinal cord surgery, but for extensive procedures it is very trying for both patient and surgeon. Because the bone and brain itself, except for some areas of the dura mater, are insensitive, a local anesthetic injected into the scalp is sufficient for many operations. Five drops of a 1:1,000 solution of epinephrine may be added to 30 ml. of a 1 per cent solution of Novocain to prolong the effectiveness of the agent and to act as a hemostatic measure by constricting the superficial blood vessels. Epinephrine is not used in patients with hypertension. A local setup which is arranged on a sterile table includes the following:

- 4 Syringes, 10 ml. Sana-Lok, manual or automatic type
- 2 ml. Syringe for measuring Adrenalin solution, or 20 ml. Luer-Lok
- 2 Needles, gauge 25, ½ inch
- 2 Needles, gauge 22, 1½ inches
- 2 Needles, gauge 22, 2½ inches
- Angulated needles, gauge 22 B.D. No 56 L.N.R., 1½ and 2½ inches
- 2 Medicine glasses (graduated for solution) with identification labels
- Novocain solution, desired strength
- Antidotes such as Adrenalin or epinephrine
- Gauze compresses and surgical towels

When a local anesthetic is being used, the nurse must continually reassure the patient and make sure he is comfortable. Other conversations should be kept to the absolute minimum and only originate from the surgeon.

For most spinal cord surgery, a general intratracheal anesthetic is preferred. Local anesthesia can be used and supplemented as need be with other agents in high cervical fracture-dislocation and in cordotomy when the surgeon wants a cooperative patient to indicate the level of analgesia obtained with each incision into the spinothalamic tracts.

PHYSICAL FACILITIES AND SETUPS

To perform neurosurgical operations the operating room facilities must be adequate and safe for preparing the patient, administering anesthetic agents, and performing the various operative steps

The facilities needed for neurosurgery are similar to those needed to perform major surgery. The neurosurgical units should be of sufficient size to accommodate extra equipment and machines. The facilities and essential pieces of furniture are described in Chapters 1 to 4.

The essential pieces of equipment for a neurosurgical unit include a standard operating room table with regular attachments and a cerebellar headrest, or an Adson chair, a cranial crossbar for holding drapes, a rectangular-shaped instrument table, two portable stands with adjustable legs, a ventricular table, a kidney-shaped instrument table, if desired, a metal connecting sheet or a portable metal tray, an electrocoagulation machine, a suction machine, a neurosurgical stimulator, a head lamp on frame holder, an infusion stand for three-bottle circuit, four footstools of various dimensions, a spotlamp, a skin preparation table, and

an extension outlet circuit (Chapter 1). In some hospitals surgeons use an overhead table, attached to the regular operating table, especially useful in a craniotomy.

Basic Qualifications for Instruments.—The instrument setup for each kind of operation should be standardized with the approval of the operating room committee (Chapter 4). The listing of instruments and other pieces of sterile and unsterile equipment should be recorded on cards. Every surgeon has specific instruments that he finds particularly useful, but deviation from a standard set should be slight. Special instruments which are used specifically for neurosurgery should be kept for that purpose only (Chapter 4).

Requirements for neurosurgical instruments are as follows:

1. The jaws of the hemostat must be pointed so that a small amount of tissue can be grasped (Chapter 4).

2. The retractors must be blunt ended; different types of self-retaining retractors are required to retract muscles and nerves, and thin pliable metal retractors are needed to retract dura and brain tissue (Figs. 152 and 153).

3. The perforators and burrs must be suitable for a thin or thick skull (Fig. 152).

4. The Gigli saws must withstand the pull exerted upon them, and they must not be bent at any time. Several saws should be sterilized for a large osteoplastic flap procedure. The Gigli guides are made of a flexible steel, usually slightly curved (Fig. 153).

5. The rongeurs should include large and small sizes, single-action types with narrow jaws which are angular and straight, double-action types with broader jaws for cerebellar operations to remove heavy bone (Figs. 153 and 154). For laminectomies, a straight rib cutter is useful for biting off the spinous processes. Kerrison punches and pituitary rongeurs are used to excise the intervertebral discs (Fig. 154).

6. Fine straight and curved dural hooks and scissors are required (Figs. 155 and 156).

7. Brain spoons are used to project the brain when the dura is being opened, to remove brain substance, or to retract brain tissue (Fig. 153).

8. The bayonet forceps, 6 or 8 inches long, with and without teeth, and the pituitary cupped forceps are used to remove tumors or hold tissues (Figs. 154 and 155).

9. Several sizes of clip holders, the short, long, and angular types are needed, and Olivecroma clips are used for aneurysms (Fig. 155).

10. Small tantalum plates may be used to close burr holes in the skull, and large plates are necessary for cranioplastics. Tools for cutting, shaping, and drilling the plates are essential items.

must be enforced to safeguard the patient and personnel from explosive hazards. (Chapter 2.)

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2 Needles, gauge 22, 1½ inches
2 Needles, gauge 22, 2½ inches
Angulated needles, gauge 22 B.D. No. 56 L.N.R., 1½ and 2½ inches
2 Medicine glasses (graduated for solution) with identification labels
Novocain solution, desired strength
Antidotes such as Adrenalin or epinephrine
Gauze compresses and surgical towels

When a local anesthetic is being used, the nurse must continually reassure the patient and make sure he is comfortable. Other conversations should be kept to the absolute minimum and only originate from the surgeon.

For most spinal cord surgery, a general intratracheal anesthetic is preferred. Local anesthesia can be used and supplemented as need be with other agents in high cervical fracture-dislocation and in cordotomy when the surgeon wants a cooperative patient to indicate the level of analgesia obtained with each incision into the spinothalamic tracts.

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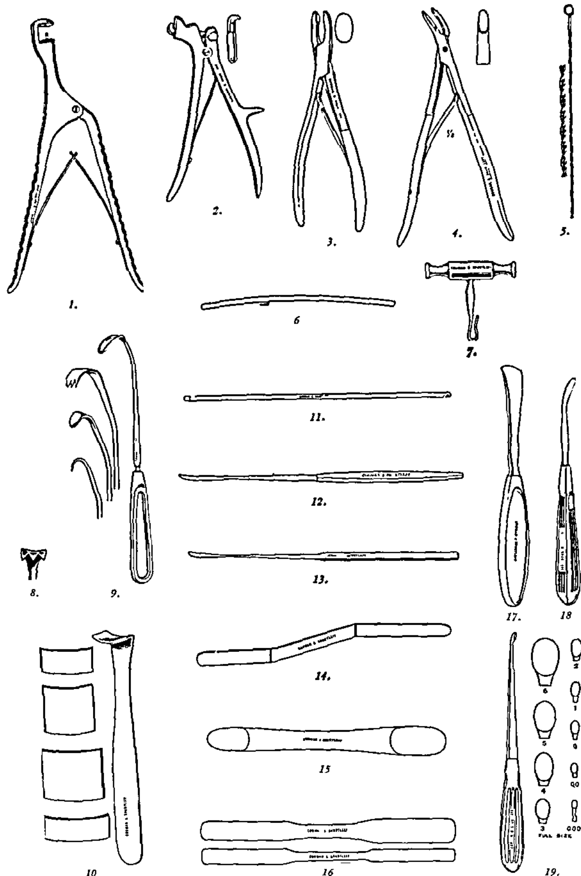


Fig. 153—Neurosurgical instruments—cont'd· *1,* Cone skull punch adjustable for skull thicknesses up to 12 mm; *2,* DeVilbiss cranial ronguer forceps with extra [illegible] ronguer with 1/8-, 3/16-, 1/4-, or 5/16-inch bite; *5,* Gigli saw, [illegible] inches, *6,* Bailey Gigli saw guide, curved or straight, 12 inche [illegible], 4-, or 6-prong, sharp or smooth, ⅝ inch wide, *9,* Cushing decompression retractor, Sachs vein retractor, 4-prong, or Sachs vein retractor smooth, Sachs single hook retractor, *10,* Cushing aluminum cortex retractors with various-sized blades, *11,* Cushing Gigli saw guide, straight, 8¾ inches, *12,* Sunday staphylorraphy elevator, slender, 8¾ inches; *13,* Adson periosteal elevator; *14,* Cushing "S" retractor, 7¾ inches; *15,* Cushing spatula spoon in sizes 6¾, 7¾, and 11 inches wide or narrow widths; *16,* Scoville flat brain spatula, flexible, wide or narrow width, 8 inches; *17,* Cushing sharp elevator, 7½ inches; *18,* Cushing Little Joker elevator, 7 inches; *19,* spinal fusion curette set, straight or angular, in various sizes The instruments shown are one third actual size. (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

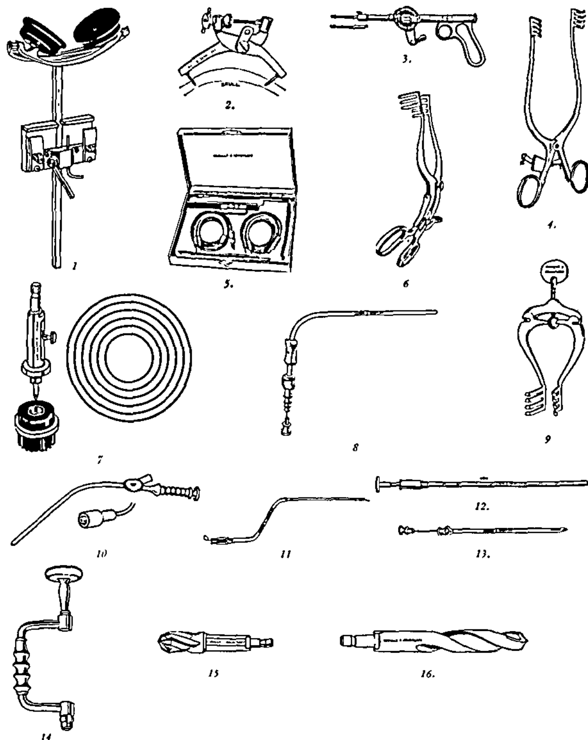


Fig. 152.—Neurosurgical instruments *1,* Dr Light Veley headrest for use in cranial surgery, except when the patient is in a face-down position; *2,* Crutchfield skull tongs, *3,* Crutchfield hand drill with set of drills; *4,* Adson cerebellum self-retaining retractor, 8 inches, with angular arms, *5,* Frazier (lighted) retractor set, *6,* self-retaining scalp retractor, shaped to fit contour of the skull; *7,* skull trephine in sizes ¾, 1, 1¼, 1½, 1¾, and 2 inches, with adjustable depth guards to fit universal handle, *8,* Frazier suction tube, angular, sizes 7, 9, and 11 F, 9 inches; *9,* Jansen scalp retractor with deep blades, *10,* Bucy-Frazier cannula and cautery cord attachment; *11,* Parhad-Poppen arteriogram needle, gauges 17 and 18, *12,* Adson brain-exploring cannula, 10 or 14 cm, made in silver; *13,* Poppen ventricular needle; *14,* Hudson brace, *15,* D'Errico perforator drill; *16,* McKenzie perforator cranial drill The instruments shown are one third actual size (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

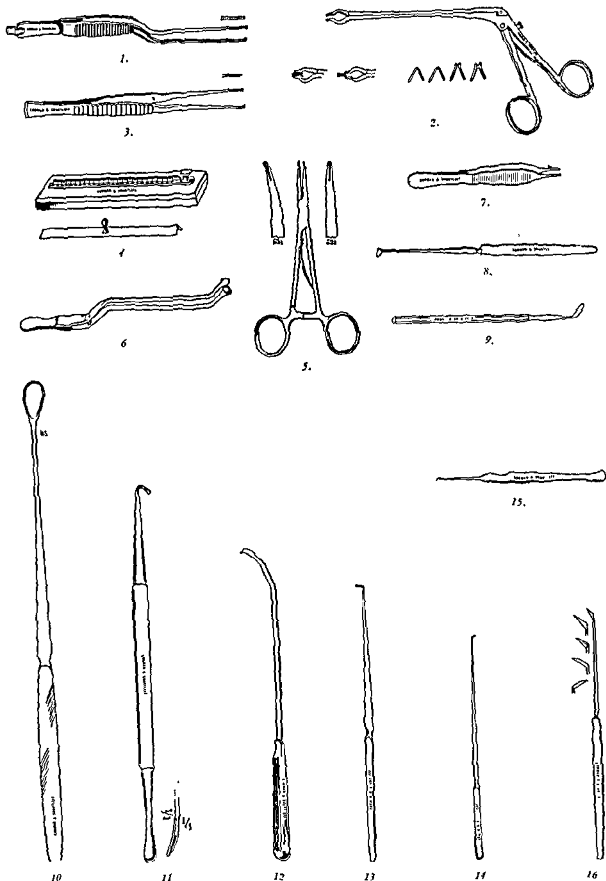
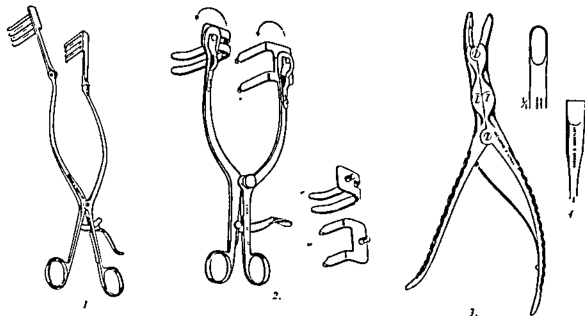
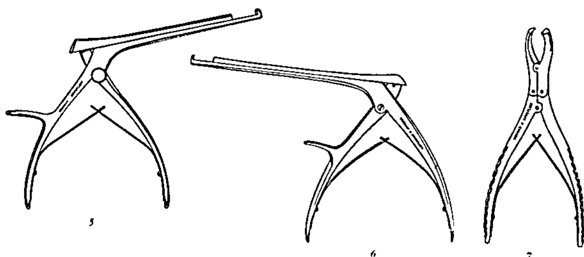
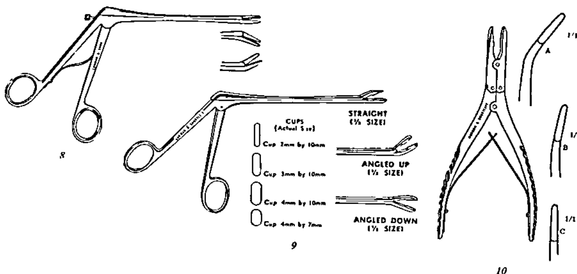


Fig 155 —Neurosurgical instruments—cont'd. *1*, Cushing bayonet tissue forceps, 1 and 2 teeth, 7¾ inches, with cautery attachment, *2*, Olivecrona clip-applying and clip-removing forceps, Olivecrona silver clips, narrow or wide, with or without wings, *3*, Cushing dressing forceps, dissecting end, with or without teeth, and serrated handle, 7 inches, *4*, McKenzie silver clip rack, *5*, McKenzie clip-applying forceps, curved handle, straight jaw, 5¼ inches, or straight handle and curved jaw, 5¾ inches; *6*, Adson hypophyseal forceps, bayonet shape, 8½ inches with curved up or down, or straight shank, *7*, Adson dura forceps, 1 and 2 teeth, 5 inches, *8*, Love nerve root retractor, straight, *9*, Frazier dura separator, 6 inches, *10*, Cushing pituitary spoon, flexible copper, 9¼ inches, in sizes 1, 2, 3, 4, and 5; *11*, Crile nerve hook and spatula, 12½ inches, *12*, Love nerve root retractor, angular; *13*, Hoen nerve hook, straight, with solid triangular handle, *14*, Cushing gasserian ganglion hook; *15*, Lahey Clinic dura hook; *16*, Bucy cordotomy knife set with forward, backward, left and right cutting. The instruments shown are one third actual size. (Courtesy Codman & Shurtleff, Inc., Boston, Mass)







iments—cont'd *1*, Beckman-Adson laminectomy retractor with hinged arms, retractor with two pairs of blades, large and small; *3*, Laksell laminectomy l, 9¾ inches; *4*, Adson periosteal elevator with chisel edge, curved or straight, 6½ inches; *5*, Spurling-Kerrison laminectomy rongeurup-biting, *6*, Spurling Kerrison laminectomy rongeur down biting, *7*, Hibbs double-action bone-cutting forceps, 8½ or 9½ inches, *8*, Scoville angular clip-applying forceps with alligator action, 7¼ inches with jaw curved up or down or straight, *9*, intervertebral disc or pituitary rongeur forceps, straight, angled-up, angled-down, with cups of four sizes, *10*, Smith-Petersen double-action rongeur, 7½ or 9½ inches, with narrow or wide blade, straight, slightly curved, or full curved The instruments shown are one third actual size The Cushing pituitary rongeur forceps, cup shaped, and Poppen or bone Gruenwald forceps are similar to those shown here (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

2 Hudson burrs (Fig. 152)
2 Cushing flat drill perforators (Fig. 152)
1 Love-Adson periosteal elevator, narrow, curved (Fig. 153)
1 Frazier or Sachs dura separator (Fig. 154)
1 Joker elevator (Fig. 153)
1 Bone curette
1 Rongeur, sharp, curved on flat
1 Adson or Lahey dural hook (Fig. 155)
1 Adson or Cushing dural forceps (Fig. 155)
3 Frazier, Poppen, or Cushing ventricular needles, 20 mm. and 80 mm., with rubber tubing and adaptor attached (Fig. 152)
1 Adson exploring cannula (Fig. 152)
2 Medicine cups
1 Specimen bottle for cerebrospinal fluid specimen
2 Luer-Lok syringes, 20 ml.
2 Stopcocks and adaptors if oxygen is used
2 Asepto syringes
1 McKenzie clip rack with clips and 2 clip holders (Fig. 155)
Bone wax
2 Needle holders
Silk sutures No. 3-0 or 2-0 swaged-on cutting needles
6 Towels
1 Fenestrated sheet
Absorbent cotton
Compressed cotton, strips
2 Electrodes, needle and ball point
1 Suction tip and tubing
12 Gauze compresses, 3 by 3 inches
Normal saline solution
Gelfoam

Also

Electrosurgical unit
Suction appartus
Collodion
Skin preparation setup
Operating table with headrest and footpiece attached, or Adson chair
Body restraints and supports

Cerebral Angiography Setups

For Open Technique.—The items include the following:

2 Scalpels with handles Nos. 4 and 3, blades 20 and 10
2 Tissue forceps, 1 and 2 teeth
2 Tissue forceps without teeth
1 Lahey aneurysm needle (Chapter 7)
4 Halsted hemostats (Chapter 4)
2 Crile hemostats, straight
2 Allis forceps
2 Volkman rake retractors, 2-prong, dull points
1 Sachs or Cushing vein retractor (Fig. 153)
2 Meyerding or New Yorker retractors, small
2 Skin hooks
1 Mayo scissors, straight
1 Metzenbaum scissors
1 Sponge-holding forceps
1 Local set and 10 ml. of 1 per cent solution of Novocain
2 Sheets, or fenestrated sheet (Chapter 4)
4 Towels
6 Gauze compresses
Gloves and gowns
2 Solution basins
1 Solution bowl
Silk Nos. 2 and 3-0 (Chapter 5)
1 Keith needle
1 Surgeon's 3/8-circle cutting needle
1 Needle holder
Adhesive tape, 2 inches wide
Antiseptic solution
Sandbag
Electrodes for electrosurgical unit
2 Suction tips, glass or Frazier type (Fig. 152)
2 Pieces of suction tubing, 3 feet
Distilled water
Sterile linen set for tables
2 Poppen arteriogram needles, gauges 17 and 18 (Fig. 152)
2 20 ml. Luer-Lok syringes for citrate solution or saline solution
2 20 ml. Luer-Lok syringes for radiopaque solution
2 2-way stopcocks, each attached to a 12-inch length venotube and adaptor

Setups for Diagnostic Procedures

Spinal Puncture Set

Sterile Items

1 3-way stopcock
1 Spinal needle, gauge 22, 2 inches
1 Spinal needle, gauge 20, 3 inches
1 Spinal needle, gauge 19, 3 inches
4 Cotton balls
1 Fenestrated sheet
1 2 ml. Luer-Lok syringe
2 Hypodermic needles, gauge 24 and 22
1 30 ml. calibrated medicine glass
2 Foerster sponge forceps
4 Towels
1 Fenestrated sheet
6 Compresses
2 Solution cups
2 Ampules 1 or 2 per cent solution Novocain
1 Ampule 1:1,000 solution of Adrenalin
1 File for glass
1 Emesis basin
3 Test tubes
1 Pair rubber gloves

Also

1 2-section water manometer
Tongue depressor
Pad and pencil
2 Stools
Stretcher
Face masks for surgeon and nurse
Cotton blanket for patient
Alcohol, 70 per cent

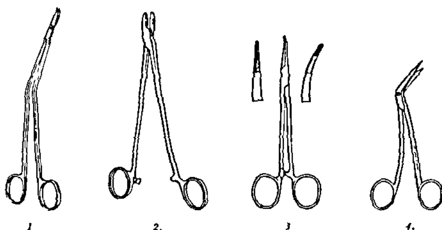


Fig 156—Dissecting instruments for neurosurgery: *1*, Dandy trigeminal scissors, double curved, 6¾ or 7¼ inches; *2*, Adson dura needle holder, 7¼ inches; *3*, Providence Hospital forceps, straight, 5½ inches; *4*, Taylor dura scissors, 5¾ inches The instruments shown are one third actual size (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

Ventriculography Setup

Sterile Items

2 Scalpels with handles No. 4 and 2 blades No. 20
1 Scalpel handle No. 3 and blade No. 11
2 Dressing forceps
1 Bayonet forceps
2 Tissue forceps, 1 and 2 teeth (Chapter 4)
1 Suture scissors
1 Mayo scissors, straight
1 Stille scissors, curved
4 Towel forceps
6 Kelly hemostats, curved (Chapter 4)
2 Crile hemostats, straight
4 Allis forceps, optional
4 Sponge-holding forceps
2 Scalp self-retaining retractors (Fig. 152)
2 Volkman rake retractors, dull-pointed
1 Hudson brace (Fig. 152)

2 Hudson burrs (Fig. 152)
2 Cushing flat drill perforators (Fig. 152)
1 Love-Adson periosteal elevator, narrow, curved (Fig. 153)
1 Frazier or Sachs dura separator (Fig. 154)
1 Joker elevator (Fig. 153)
1 Bone curette
1 Rongeur, sharp, curved on flat
1 Adson or Lahey dural hook (Fig. 155)
1 Adson or Cushing dural forceps (Fig. 155)
3 Frazier, Poppen, or Cushing ventricular needles, 20 mm. and 80 mm., with rubber tubing and adaptor attached (Fig. 152)
1 Adson exploring cannula (Fig. 152)
2 Medicine cups
1 Specimen bottle for cerebrospinal fluid specimen
2 Luer-Lok syringes, 20 ml.
2 Stopcocks and adaptors if oxygen is used
2 Asepto syringes
1 McKenzie clip rack with clips and 2 clip holders (Fig. 155)
Bone wax
2 Needle holders
Silk sutures No. 3-0 or 2-0 swaged-on cutting needles
6 Towels
1 Fenestrated sheet
Absorbent cotton
Compressed cotton, strips
2 Electrodes, needle and ball point
1 Suction tip and tubing
12 Gauze compresses, 3 by 3 inches
Normal saline solution
Gelfoam

Also

Electrosurgical unit
Suction appartus
Collodion
Skin preparation setup
Operating table with headrest and footpiece attached, or Adson chair
Body restraints and supports

Cerebral Angiography Setups

For Open Technique.—The items include the following:

2 Scalpels with handles Nos. 4 and 3, blades 20 and 10
2 Tissue forceps, 1 and 2 teeth
2 Tissue forceps without teeth
1 Lahey aneurysm needle (Chapter 7)
4 Halsted hemostats (Chapter 4)
2 Crile hemostats, straight
2 Allis forceps
2 Volkman rake retractors, 2-prong, dull points
1 Sachs or Cushing vein retractor (Fig. 153)
2 Meyerding or New Yorker retractors, small
2 Skin hooks
1 Mayo scissors, straight
1 Metzenbaum scissors
1 Sponge-holding forceps
1 Local set and 10 ml. of 1 per cent solution of Novocain
2 Sheets, or fenestrated sheet (Chapter 4)
4 Towels
6 Gauze compresses
Gloves and gowns
2 Solution basins
1 Solution bowl
Silk Nos. 2 and 3-0 (Chapter 5)
1 Keith needle
1 Surgeon's ⅜-circle cutting needle
1 Needle holder
Adhesive tape, 2 inches wide
Antiseptic solution
Sandbag
Electrodes for electrosurgical unit
2 Suction tips, glass or Frazier type (Fig. 152)
2 Pieces of suction tubing, 3 feet
Distilled water
Sterile linen set for tables
2 Poppen arteriogram needles, gauges 17 and 18 (Fig. 152)
2 20 ml. Luer-Lok syringes for citrate solution or saline solution
2 20 ml. Luer-Lok syringes for radiopaque solution
2 2-way stopcocks, each attached to a 12-inch length venotube and adaptor

Radiopaque substance, i.e., 60 ml. of a 35 per cent solution of Diodrast, or a 30 per cent solution of Urokon

Also

Electrosurgical machine
Suction apparatus
Alcohol 70 per cent

For Closed Technique.—The sterile items include the following:

1 Sheet for instrument table
1 Tray cover
Gloves
Gowns
6 Towels
1 Fenestrated or small draping sheet
2 Sponge-holding forceps
1 Solution basin
2 Stopcocks, 2-way type
2 Intravenous sets, disposal type
4 Luer-Lok 20 ml. syringes
2 Poppen curved needles, gauge 17, or straight arterial needle
1 Intravenous needle, gauge 18, for drawing up dye
Normal saline solution
Heparin or citrate solution, if desired
2 Gauze dressings, 4 by 8 inches
6 Gauze compresses, 3 by 3 inches
Radiopaque solution, as desired
Tracheostomy set

Also

Skin preparation setup
Small pad or halter for supporting neck
Instrument table and portable stand

Osteoplastic Craniotomy Setup

The items include the following:

General Instruments

2 Volkman or Oldberg 3-pronged, sharp or blunt retractors
2 Greene retractors
2 Senn or Mayo-Collins retractors
2 Beckman-Adson laminectomy, self-retaining retractors (Fig. 154)
2 Adson cerebellum, self-retaining retractors (Fig. 152)
2 Sachs blades, blunt points, retractors
1 Jansen mastoid, self-retaining retractor
4 Scalpel handles, 2 No. 4, 1 No. 7, 1 No. 3 L
4 Scalpel blades, 2 No 21, 1 No. 15, 1 No. 11
4 Cushing or Adson tissue forceps, 1 and 2 teeth, 4½ inches (Fig. 155)
2 Cushing dressing forceps (Fig. 155)
2 Tissue forceps, 1 and 2 teeth, 5½ inches
2 Tissue forceps without teeth
2 Bayonet dressing forceps
1 Stille scissors, pointed, 6¼ inches
2 Mayo scissors, curved on flat, 5½ inches
1 Suture scissors
1 Metzenbaum or Mayo-Harrington scissors, 7 inches
4 Needle holders, 2 heavy, 2 light, 5½ or 7 inches
6 Backhaus towel forceps
36 Adson or Raney skin clips, autoclips, optional
2 Clip holders or automatic holders
36 Crile or Providence hemostats, straight, sharp points, 5½ inches
12 Kelley-Mayo hemostats, curved, sharp points
6 Halsted hemostats, straight, 4½ inches (Chapter 4)
2 Ochsner forceps, 6¼ inches
2 Lahey forceps
2 Mayo-Pean hemostats, curved, 6¼ inches
2 Glass suction tips
3 Adson or Bucy suction tips (Fig. 152)
3 Rubber suction tubes, 5 feet long
2 Asepto bulb syringes, 2 oz.
3 Spinal needles, 1 blunt gauge 20, 2 sharp gauge 20 and 22, with rubber tubing at ends
2 20 ml. syringes with adaptors
Electrosurgical unit with 2 cords, electrodes with needle, loop, and ball

points; foot attachment, ground cord and plate
2 Medicine glasses
1 Thermometer
3 Tubes of bone wax
2 Catheters Nos. 16 and 10 F
1 Penrose drain
2 Adson periosteal elevators Nos. 1 and 4 (Fig. 153)
1 Joker elevator (Fig. 153)
1 Sachs elevator, curved type (Fig. 153)
2 Periosteal elevators, sharpened, 1 broad and 1 pointed (Fig. 153)
1 Chisel
2 Alligator forceps (Fig. 154)
2 Hudson or Lane-Adson, Freer semi-sharp, curved elevators (Fig. 155)

Bone Flap.—Instruments include the following:

2 Hudson braces (Fig. 152)
2 Cushing or Adson flat perforators and enlarging burrs, or McKenzie twist drill and burr (Fig. 152)
1 Electric-driven drill and burr
4 Adson, Bailey, or Davis conductors for Gigli saws (Fig. 153)
8 Gigli saws, Stille type, 2 Gigli handles (Fig. 153)
1 Adson drill guide and dura protector, if desired
Tantalum plates, small size, for burr holes
Wire scissors
1 D'Errico perforator drill, if desired
1 Cone skull punch (Fig. 153)
1 Adson, Hudson, or DeVilbiss, straight rongeur (Fig. 153)
1 Hudson or Adson cranial, double action rongeur (Fig. 153)
1 Stille-Liston, straight, double action rongeur (Fig. 153)
2 Bacon, Stookey, or Stille, right and left, angled sideways, rongeur
2 Bone curettes, long (Fig. 153)
2 Kerrison mastoid rongeurs, desired size (Fig. 154)
1 Moundivizi cranial rongeur forceps, optional
1 Hibbs bone-cutting forceps, 8 inches (Fig. 154)

Dura Opening and Exploration of Brain.—Instruments include the following:

2 Adson brain retractors, with or without lights, suitable size (Fig. 152)
1 Frazier cerebellar retractor, thin end pliable (Fig. 152)
1 Grooved director
4 Adson or Cushing dural hooks, 2 sharp and 2 blunt (Fig. 155)
1 Mayo ureter knife or 3 L handle, blade No. 11
1 Monro or Adson brain scissors, curved, $5\frac{1}{2}$ inches (Fig. 156)
2 Dural dissecting scissors (Fig 156)
1 Lane-Adson periosteal elevator
1 Frazier dura separator, 6 inches (Fig. 153)
1 Silver probe
2 Davis or Cushing flexible, silver brain retractors (Fig. 155)
2 Adson brain-exploring cannulas (Fig. 152)
3 Brain spatulas, flexible spoons (Fig. 153)
McKenzie rack with silver clips (Fig. 155)
3 Scoops, various sizes
3 Adson silver clip holders, 1 short, 2 long (Fig. 155)
1 Metal tray for compressed cotton pledgets
1 Adson, Cushing, or Hudson vein retractor (Fig. 155)
12 Mosquito forceps, straight jaws

Removal of Tumor.—Instruments include the following:

2 Adson or Oldberg retractors, with light cord, battery (ganglion light)
1 Cortical stimulation point, cord, and battery
2 Cushing or Poppen pituitary rongeur forceps (Fig 154)
1 Adson, Oldberg, or Gruenwald alligator forceps (Fig. 154)

2 Adson hypophyseal forceps, suitable shapes (Fig. 155)
2 Cushing pituitary spoons, pliable, suitable sizes
1 Dandy or Adson ganglion scissors, 7 inches (Fig. 156)
2 Petri dishes
2 Specimen bottles
2 Ethmoid ring curettes
1 Metal ruler

Sutures.—The types and sizes include the following:

Silk Nos. 6-0 and 5-0 fused to curved, taper-point needles (Chapter 5)
Chromic gut Nos. 0 and 2-0, silk Nos. 4-0 and 3-0
Stainless steel wire No 28 or 30
2 Mayo needles ½-circle, taper-point, No. 3
4 Murphy ½-circle, trocar-point, No. 2, *or* 6 French-eyed needles, suitable size, or swaged-on needles (Chapter 5)

Additional sterile items include the following:

Local syringe and needle set
Novocain solution
Compressed cotton, desired sizes
Normal saline solution
Zinker's solution
Silver foil sheets, if desired
Gelfoam
Fine-mesh gauze sponges
Fluffs, cotton balls
Crinoline helmet, if desired
Cotton elastic bandage or plain gauze bandage
Infusion set, 3-circuit type, and phlebotomy set
Normal saline solution for infusion and whole blood
Emergency drugs for cardiac resuscitation
Craniotomy slit sheet (Chapter 4)
Towels
2 Single sheets
Cotton plug for ear
Major operative pack
Glove and gown sets

Laminectomy and Excision of Herniated Lumbar Disc Setup

Considerations—A complete setup is described which is basic for all types of spinal cord surgery, including intervertebral discs. Some surgeons prefer special instruments, such as dental burrs, which are used to expose the laterally placed cervical discs. When a laminectomy is performed in an infant or small child, small clamps and rongeurs must replace the standard-sized instruments. When subarachnoid shunting procedures are contemplated, polyethylene tubing of appropriate size must be available.

When a spinal fusion is to be combined with excision of an intervertebral disc, such bone instruments as bone screws and bone-grafting equipment must be added to the standard setup (Chapter 17).

The items include the following:

Instruments

2 Billroth or Krause retractors, 6-prong, dull points
2 Roux, Mayo-Collins, or Murphy retractors (Chapter 4)
4 Hibbs or Meyerding retractors, various sizes
1 Beckman-Adson or Hoen-Adson laminectomy retractors, optional (Fig. 154)
Frazier or Adson self-retaining cerebellum retractor, optional (Fig. 152)
2 Scalpels, handles No. 4 and blades No. 21 or 20
1 Scalpel, handle No. 7 and blade No. 11
1 Mayo ureteral knife
1 Stille scissors, curved, 7 inches (Chapter 4)
1 Mayo dissecting scissors, curved, 6¾ inches
1 Mayo dissecting, straight, sharp, 6¾ inches
1 Mayo suture scissors, 5½ inches
1 Mayo dissecting scissors with wedge blades, 7 inches

3 Tissue forceps, 1 and 2 teeth—2, 6 inches; 1, 8 inches
3 Dressing forceps—2, 6 inches; 1, 7 inches
2 Strands Michel clips No. 22
2 Michel forceps, wide, or 1 autoclip, magazine holder, and applicators
1 Autoclip remover
6 Foerster sponge-holding forceps, 9¾ inches
2 Crile-Wood needle holders, heavy, 6¼ inches (Chapter 4)
1 Adson needle holder, 7 inches (Fig. 156)
4 Rochester-Pean hemostats, curved, 6¼ inches (Chapter 4)
6 Crile hemostats, sharp points, straight, 5½ inches
6 Kelly
2 Ochsn
4 Lahey
12 Mosquito forceps, straight jaw
4 Allis forceps (add 15 for spina bifida)
3 Adson or Frazier suction tips, 2 sizes (Fig. 152)
1 Glass suction tip
2 Rubber tubing lengths for suction
1 Electrosurgical unit with cord, electrodes, needle and ball points
1 Sachs, Love-Adson, or Oldberg periosteal elevator, curved (Fig. 153)
1 Adson or Lane periosteal elevator, sharp, wide (Fig. 153)
1 Adson or Hibbs laminectomy chisel (Fig. 153)
2 Hibbs-Spratt bone curettes, long
1 Hudson or Adson cranial bone, angular, double-action rongeur (Fig. 153)
1 Ruskin or Stille-Liston bone-cutting forceps, straight (Fig. 154)
1 Stille-Luer rongeur, side-cutting
2 Bacon rongeurs, side-cutting right and left
1 Oldberg or Love-Kerrison rongeur (Fig. 154)
1 Love-Gruenwald laminectomy rongeur (Fig. 154)
1 Noyes or Poppen pituitary rongeur forceps (Fig. 154)
2 Hartmann bayonet forceps, straight, 7 inches
1 Adson hypophyseal forceps (Fig. 155)
1 McKenzie or Cushing silver clip on rack (Fig. 155)
2 Silver clip holders, 7 inches long
2 Tubes of bone wax
2 Probes, flexible, 7 inches
2 Adson hemostatic forceps, straight, 7¼ inches
2 Adson hemostatic forceps, curved, 7¼ inches
1 Cushing or Joker elevator (Fig. 153)
1 Cushing vein retractor (Fig. 153)
3 Cushing pituitary spoons, 3 sizes
1 Adson or Frazier dissecting dural hook, blunt (Fig. 155)
1 Love or Haynes, angular nerve retractor (Fig. 153)
1 Adson tissue forceps, 7 inches, 1 and 2 teeth
1 Adson dura scissors, 7¼ inches (Fig. 156)
1 Silver probe
1 Asepto syringe, 2 ounces
1 Piece of metal sheeting for compressed cotton sponges
1 20 ml. syringe
1 Adaptor and rubber connector
1 Spinal needle, gauge 18, optional
1 Penrose drain

Textiles

General major pack (Chapter 4)
Gauze compresses, desired types and sizes
Gelfoam
Fenestrated slit sheet
Compressed cotton pledgets, various sizes

Sutures

1 Plain surgical gut No. 0 (Chapter 5)
2 Chromic gut Nos. 0 and 1
Silk Nos. 1, 2-0, and 4-0
Silk No. 2-0 swaged-on ½-circle, taper-point needles
If swaged on sutures are not available

Murphy No 3, ½-circle and taper-point
Mayo No. 3, ½-circle, trocar- or taper-point (Chapter 5).

2 Adson hypophyseal forceps, suitable shapes (Fig. 155)
2 Cushing pituitary spoons, pliable, suitable sizes
1 Dandy or Adson ganglion scissors, 7 inches (Fig. 156)
2 Petri dishes
2 Specimen bottles
2 Ethmoid ring curettes
1 Metal ruler

Sutures.—The types and sizes include the following:

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Fluffs, cotton balls
Crinoline helmet, if desired
Cotton elastic bandage or plain gauze bandage
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When a spinal fusion is to be combined with excision of an intervertebral disc, such bone instruments as bone screws and bone-grafting equipment must be added to the standard setup (Chapter 17).

The items include the following:

Instruments

2 Billroth or Krause retractors, 6-prong, dull points
2 Roux, Mayo-Collins, or Murphy retractors (Chapter 4)
4 Hibbs or Meyerding retractors, various sizes
1 Beckman-Adson or Hoen-Adson laminectomy retractors, optional (Fig 154)
Frazier or Adson self-retaining cerebellum retractor, optional (Fig. 152)
2 Scalpels, handles No. 4 and blades No. 21 or 20
1 Scalpel, handle No. 7 and blade No. 11
1 Mayo ureteral knife
1 Stille scissors, curved, 7 inches (Chapter 4)
1 Mayo dissecting scissors, curved, 6¾ inches
1 Mayo dissecting, straight, sharp, 6¾ inches
1 Mayo suture scissors, 5½ inches
1 Mayo dissecting scissors with wedge blades, 7 inches

For a cervical or upper thoracic laminectomy, the patient is placed in a prone position, with the head properly supported in a cerebellar frame (Chapter 9). In some clinics the upright sitting position is held in great favor, especially for cervical disc surgery; however, with the patient in this position the danger of air embolism is present.

To perform a lower thoracic or lumbar laminectomy the patient is frequently placed on a regular operating table in the prone position, with the head turned to one side, using firm rolls or sandbags to elevate the chest and abdomen and support the legs. Details of the prone position are described in Chapter 9. For lumbar disc operations it is important to have the patient's knees well flexed and the legs supported to relieve tension on the lumbosacral nerve roots. This may be accomplished, when using the regular operating table, by flexing it after the patient is positioned, being certain that the break of the table comes at the upper thighs, in line with the pubis. If the break exerts pressure on the abdomen, venous distention of the vertebral veins can occur to an annoying, and even dangerous, degree (Chapter 4). The knees are flexed at a right angle and the legs held and supported by a knee strap which is placed between two foot supports as used in vaginal surgery (Chapter 15). In some hospitals a prone pad is used. In some cases the patient is placed in the lateral decubitus position which requires correct placement of the extremities and sandbags to stabilize the patient (Chapter 9).

When a cervical sympathectomy is to be performed, using an anterior approach, the patient is placed on the operating table in a supine position, or, if the paraspinal incision is to be employed, he is placed in a prone or a posterolateral position.

Since a lumbar sympathectomy may be done through a transabdominal muscle-splitting incision similar to the classical McBurney, or through a flank or lumbodorsal incision, the appropriate position will vary from a supine to a lateral decubitus, with elevation by a kidney rack (Chapters 9 and 11). When the Smithwick type of thoracolumbar sympathectomy is to be done, the kidney rack may be used because a posterior doroslumbar incision is employed (Chapter 16).

Preparation of the Skin Area and Draping Procedure.—The principles to be considered in developing written procedures for skin cleansing are described in Chapter 3. Shaving the scalp immediately prior to surgery is a standard procedure today. Small cuts, if made, are then to be considered clean wounds. When cuts are made the day or night before surgery, the wounds have time to become infected or at least contaminated (Fig. 11). A woman's hair is always saved for the purpose of making a transformation later.

The skin is cleansed and shaved in the operating room, if possible, and by a member of the operating team The surgeon will indicate the amount of hair to be removed for a specific procedure.

For laminectomy and sympathectomy operations the extent of the skin area to be shaved and cleansed is described and illustrated in Chapter 3.

The various draping procedures that may be used are described in Chapters 4, 9, and 17. One of the following fenestrated sheets is commonly used: the tri-

Unsterile Equipment

Cerebellar headrest
Padded cuff bands, or shoulder braces
Kidney rest
Long rollers
Footpiece
Sandbag
1 Large pillow
2 Small pillows
Restraint straps
Ether screen
Suction machine and suction apparatus
Lamps

Chordotomy and Rhizotomy Setup

For chordotomy and rhizotomy the setup is the same as for laminectomy, including chordotomy knife (Fig. 155) or razor blade, if desired.

PREPARATION OF THE PATIENT IN THE OPERATING ROOM

Admission and Positioning the Patient for Surgery.—The members of the team work together as they carry out the rules defined by the department. The position of the patient on the operating table should provide for a direct exposure to the pathology and should place the least physiologic stress on the patient. General principles of admitting and positioning the patient for surgery are described in Chapter 4.

When a craniotomy is to be performed, it is difficult to meet the needs of the surgeon and ensure the safety and comfort of the patient. (Chapters 3 and 4.) The reverse Trendelenburg or sitting position decreases the amount of venous bleeding, but it may lead to serious air embolism if the venous pressure should fall lower than atmospheric pressure. The complications due to malposition are discussed in Chapter 4

To perform a temporal retrogasserian neuroectomy, the patient may be placed on the operating table in a supine position, with the head turned to the side; however, it can be difficult for the surgeon because the blood pools in the wound The sitting position provides for a clearer exposure, but during surgery constant retraction of the temporal lobe in an upward direction is tiring to the operator and is more traumatic to the patient. In general, most supratentorial operations are performed with the patient in a modified supine position and his head rotated to the side opposite that of the proposed craniotomy. The head is slightly elevated and supported by a cotton roll which is doughnut-shaped, and a foam-rubber pad or small sandbag is placed under the affected shoulder. The arms and hands are secured at the side, using a restraint sheet or padded cuffs. A restraint strap is fastened around the table over the legs, and the feet are supported by a small pad to prevent plantar flexion (Chapter 4).

A ventriculogram is done with the patient in a supine position and the occiput resting on a cerebellar crutch attached to the operating table, which is tilted downward about 20 degrees (Fig 152) Posterior fossa craniotomy may be performed with the patient on a cerebellar frame and in a prone position. If a unilateral approach is to be used, the lateral decubitus position may be desired, or the upright position using a headrest.

Hemostatic Measures

The first consideration is control of hemorrhage from the scalp. Many methods employed in the past have been replaced by simply compressing the edges of the wound with gauze sponges and fingers during the initial incision. Then hemostatic clips or clamps are applied. When clips are used, they are applied so as to include galea and skin edge, while the clamps are attached directly to the galea, then everted. Preference of the surgeons for one or the other varies.

Electrocoagulation has become an essential part of the neurosurgical setup. The nursing personnel must understand the construction of the machine before attempting to regulate it, and they must carry out proper safety measures (Chapter 4). Electrocoagulation is used to stop bleeding in the galea and the periosteum, on the surface of the dura and the spinal cord, and in the brain. The coagulation current is used for sealing the blood vessels. The electric current is applied to the forceps, a metal suction tip, or other instrument, which acts as a conducting tool. To get good results the effectiveness of the cautery must contact the vessel in a dry field; thus suctioning is necessary to remove the blood as the contact is made between the current and bleeding point.

Although the electrocautery is principally used to control bleeding, it also is used for cutting, in which case a lower frequency current is employed. When the surgeon is using an electro-knife or loop electrode to cut and remove a tumor of the brain, the circulating nurse should stand by the machine to adjust the current as he desires.

Bone wax, which is an essential hemostatic material, must be prepared for all cranial and spinal cord operations. The preparation of bone wax is described in Chapter 5. The surgeon firmly rubs the wax into the bleeding surface of the bone after all periosteum has been scraped off.

Gauze compresses or fluffs are used to control bleeding prior to entering the skull or spinal cord, as in any general surgical procedure (Chapter 4). Compressed cotton pledgets or strips are used in place of gauze sponges to control bleeding beneath the skull and around the spinal cord. Because the coarse cotton mesh will injure fragile tissues, the compressed cotton should be of the finest quality, but not so compressed that it has lost its absorbent property. The compressed cotton sheets are cut in various sizes. Each clinic has several standard sizes suitable to its specific needs, but, in general, the strips are usually three or four times longer than they are wide. A silk thread may be attached to some strips or pledgets, which are packaged according to size and then autoclaved.

During the operation, the nurse moistens cotton strips and pledgets in normal saline or Ringer's solution and stores them on a piece of metal to preserve their moisture. Occasionally, loose wet cotton balls are temporarily used to pack the bleeding cavity left after a tumor has been removed. Gentle pressure of this kind will often stop troublesome venous ooze.

Silver clips are always included in each setup. The McKenzie clips are made of pieces of flat ribbon wire which are bent in the shape of an open triangle

facial sheet, the slit brain sheet, or the split spinal sheet (Chapter 4). A craniotomy pack usually includes two small sheets, four towels, and a slit (fenestrated) sheet. For a craniotomy, some surgeons use one sheet, approximately 12 feet long with a split at one end. At the end of the split toward the middle of the sheet is a circular opening which is bound with cotton tape. This opening fits neatly around the head and the edges may be sutured to the scalp. A similar sheet, about 6 feet long, is used for a ventriculogram. In some departments single waterproofed sheets are used (Chapter 4).

When preparing the patient for a craniotomy, the surgeon inserts a cotton plug in the affected ear. A small sheet is folded in half transversely, and a towel is placed longitudinally over it so that one side of the towel is level with the fold of the sheet. They are placed under the patient's head, and the remaining part of the sheet falls below the headrest. The towel is brought around the patient's head, leaving the proposed incisional site exposed; then the ends of the towel are fastened to the skin, using a towel forceps. A small sheet is draped over the chest and abdomen, covering the metal sheet and the screen brace which have been attached previously. Towels, folded in half longitudinally, are placed around the prepared skin area and held in place by silk sutures. A light-weight slit sheet is draped over the patient. The top end of the sheet is allowed to fall below the head of the table and is placed in a bucket. If the opening in the sheet is too long for the incision, it is made smaller, using sponge forceps.

For laminectomy, the proposed operative area is surrounded with four towels which are held in place with silk sutures and the patient is draped with a fenestrated (slit) sheet. If combined operation of protruded intervertebral disc and fusion is done, the long end of the slit sheet is placed toward the head of the patient, and if a bone graft is to be taken, the affected leg is draped as described for an orthopedic procedure (Chapter 17).

For cervical sympathectomy, a thyroid or neck pack may be used (Chapter 7). If a posterior approach is to be used for cervicothoracic or thoracolumbar sympathectomy, the patient is draped as described for pneumonectomy, using a sheet with a large opening (Chapter 9). When an anterolateral incision is contemplated, an orthopedic pack and a laparotomy sheet are generally used (Chapter 17).

When the patient is placed on the operating table in an upright or sitting position, using a headrest or Adson chair, the slit brain sheet is used. When he is placed in a prone position, the slit fusion sheet is needed.

NEUROSURGICAL TECHNIQUES

The extent of a modern operation is often determined not by the physiologic problems involved, but by the degree of neurologic disability which may be expected following surgery.[4,10,13,14,20] The techniques which have made it possible to reach this state of surgical progress include means of controlling the multiple physiologic needs of the patient, the use of anesthetic agents, blood replacement, antibiotics, and development of more accurate diagnostic methods.[16,18,19] Those operative techniques which are significantly important and which are of special interest to neurosurgical nursing will be described.

DIAGNOSTIC PROCEDURES

Accurate neurosurgical diagnosis is generally only possible by specific studies of the cerebrospinal fluid, the ventricular system, and the cerebral vascular apparatus.[11,12,15,20] Because most of these procedures are performed in the operating room or delegated to the operating room staff, they will be described in some detail. Such tests as electroencephalograms, x-ray tomograms, and radioisotope methods of localizing brain tumors are the responsibility of other departments, so they will not be considered.

Spinal Puncture

Definition.—The introduction of a hollow-bore needle into the spinal subarachnoid space, usually below the level of the termination of the spinal cord, and removal of spinal fluid.

Purposes.—Spinal puncture is performed for diagnostic and, less frequently, for therapeutic reasons. The test is usually carried out to examine the spinal fluid itself, to note its physical, chemical, and microscopic characteristics; but it may also be helpful in ascertaining spinal fluid pressure and such abnormalities of circulation as spinal subarachnoid block.[4,9]

Considerations.—Normal spinal fluid is crystal clear and colorless, and, when the patient is in a relaxed lateral or supine position, the pressure of the spinal fluid varies from 50 to 180 mm. of mercury. If pressure is exerted on the jugular veins, the cerebral venous pressure is increased. This is reflected by a rise in the cerebrospinal fluid pressure as registered on the spinal manometer if no block in the circulation is present (Queckenstedt test). Similarly, if needles are simultaneously placed in the spinal subarachnoid space and in a cerebral ventricle, then the respective pressures observed as the patient is changed from the upright position to a Trendelenburg position make it possible to determine the presence of an obstruction between the two puncture sites (ventriculospinal manometrics). If an obstructive or communicating hydrocephalus is suspected, the dye test is used. When a dye such as phenosulfonphthalein is placed in a lateral ventricle, it will appear in the spinal subarachnoid space promptly if the two communicate normally (Fig. 146).

Spinal fluid drainage is frequently used as an adjunct to intracranial surgery of aneurysms, pituitary tumors, and section of cranial nerves in the posterior fossa. A needle is inserted prior to the operation; fluid is withdrawn to give a better exposure of the structures With careful sterile technique the fluid may be returned at the completion of the procedure.

Spinal puncture is done to introduce a radiopaque material in the performance of myelography or, occasionally, to inject therapeutic drugs into the subarachnoid space when an infection is present in the central nervous system.

A spinal puncture is not done in the presence of a local infection at the selected site of puncture or increased intracranial pressure resulting from expanding intracranial lesion.

Setup, Position, Skin Preparation, and Draping Procedure.—Sterile and unsterile items are listed under setups Routine skin preparation is followed

and are stored on a sliding metal rack (Fig. 155). The nurse secures the clip in the jaws of a special holder which the surgeon uses to place the clip on the bleeding vessel. These clips are used if electrocoagulation is insufficient or dangerous because of its thermal effect on neighboring structures or when a silk ligature would be difficult to place or unsuitable to use on a vessel. The Olivecrona clip is sometimes used in trapping or clipping the neck of large aneurysms (Fig 155).

Silk sutures, *size 4-0* or *5-0*, swaged-on to curved, taper-point needles are needed to ligate bleeding vessels, to retract, or to close the dural membrane. Silk sutures, size 3-0, are used to close galeal and skin layers; and silk, size 2-0, is used for approximating heavier tissues, such as the paraspinal muscles (Chapter 5).

In some situations when electrocoagulation is ineffective, a hemostatic substance or solution may be used. After removal of certain tumors, compressed cotton strips saturated with Zenker's solution or thrombin may be placed in the tumor bed. When a pledget saturated with Zenker's solution is used, it must be handled carefully so that the solution will not drop on to the tissue around the bleeding vessel When it is used to control bleeding in the bed of a pituitary tumor, the optic nerve may be permanently injured by the bichloride of mercury in the Zenker's solution.

A hemostatic substance, such as Gelfoam or fibrin foam, is used to stop hemorrhage from large blood vessels or sinuses or from an oozing surface in a tumor bed. The nurse cuts the hemostatic material into pieces of suitable shape and size and hands the surgeon a moist compressed cotton strip which he places over the hemostatic material. The surgeon holds the material and cotton pad against the bleeding area for several minutes by means of a forceps or suction tip; then he removes the cotton strip, leaving the hemostatic material adherent to the bleeding area Fresh *autograft muscle stamps obtained from* adjacent exposed muscle, or from fresh homografts, are often much more effective than other substances in controlling bleeding from large vessels.

Because washing the wound with warm normal saline solution is an effective hemostatic measure, the nurse should always have an Asepto syringe and suction set within reach of the surgeon. The suction apparatus is the best tool to keep the wound dry and permit control of hemorrhage (Fig. 147). Although Cushing used a glass tube for suctioning blood and secretions from the wound, today metal tubes, the Adson, Bucy, and Frazier types, are often used. The metal tubes are also used to conduct the coagulation current to the bleeding vessel (Fig 152)

Suctioning is used to (1) keep the wound clean and dry in order to identify the active bleeding source, (2) remove irrigating fluid rapidly, (3) suck out necrotic or traumatized brain tissue or soft brain tumors; (4) empty an abscessed cavity, (5) evacuate cerebrospinal fluid from a ventricle or subarachnoid space; (6) hold a tumor during its removal, (7) compress a bleeding vessel; (8) conduct the electrocautery spark to a bleeding area via a metal sucker.

Blood loss is replaced with whole blood and intravenous solutions of saline and glucose at various rates of flow according to the surgeon's or anesthetist's order (Chapter 4).

are filled more readily (Fig. 144). Some surgeons prefer to inject a considerable amount of air without withdrawing the fluid, while others always remove more fluid than they inject air. X-ray pictures of the head are then taken in several projections. A local or general anesthetic suffices; however, many surgeons prefer the latter as the procedure can be distressing to the patient.

Ventriculography

Definition.—Through two openings made in either side of the skull the meninges are incised, air is injected, and fluid removed by means of direct ventricular puncture.

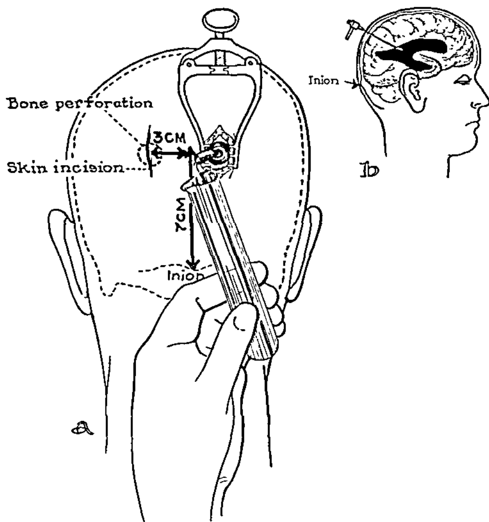


Fig 157 —Occipital burr holes for ventriculography (From Richards, V Surgery for General Practice, St Louis, 1956, The C. V Mosby Co)

Purpose.—Ventriculography is done to outline the cerebral ventricles in the presence of increased intracranial pressure or tumor. Beyond infancy, when the anterior fontanel closes, it is necessary to perform preliminary burr holes.[4,11,15-17,19,20] This procedure is done in the operating room. (Fig. 157.)

(Chapter 3). For adults, a lateral position with head bent forward and knees drawn up and supported to separate the vertebras, or a sitting position with supports, is used. For infants, a lateral position with restraints is preferred (Chapters 4 and 10).

Procedure.—The area is prepared and anesthetized. The spinal needle is usually inserted between the second and third or third and fourth vertebras. The needle is passed through the dura mater and the cerebrospinal fluid is removed. In small infants, the needle may be passed through the anterior fontanel into the lateral ventricles (ventricular tap).[18,20]

Cisternal Puncture

Definition.—The introduction of a spinal needle into the cisterna magna just below the foramen magnum, and the removal of spinal fluid.

Considerations.—A cisternal puncture, which carries greater risk than a spinal puncture, is used only on special indications, such as the inability to obtain fluid or the presence of infection at the usual lumbar site.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for spinal puncture.

Procedure.—The hair covering the occiput is removed; the patient is placed in a lateral decubitus position with the head supported so that the spinous processes of the vertebras and the center of the occiput are in line; then the head is bent slightly forward. The needle is inserted just below the occipital protuberance and introduced through the dura mater. The cerebrospinal fluid is removed; it may be replaced by an opaque drug or by air if an encephalogram is to be done.

Myelography

Definition.—The injection of a radiopaque oil, usually Pantopaque, into the spinal subarachnoid space for x-ray demonstration of spinal mass lesions.

Purpose.—To diagnose and accurately determine location of cord tumors.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for spinal puncture, adding an ampule of Pantopaque and a 20 ml. Luer-Lok syringe.

Procedure.—Myelography is done in the x-ray department with the patient on a fluoroscopic table. The radiopaque substance is ordinarily removed following a review of the wet x-ray films

Pneumoencephalography

Definition.—The injection of air into the spinal subarachnoid space to outline the ventricular system and cranial subarachnoid space.

Setup, Skin Preparation, and Draping Procedure.—As described for spinal puncture under listing of setups and preparation of the patient.

Procedure.—A spinal puncture is made and the air is introduced with the patient in an upright position. If the patient's neck is slightly flexed, better filling of the ventricles is obtained. Usually when the neck is extended the basal cisterns

Cerebral Angiography (Arteriogram)

Definition.—An intra-arterial injection of a radiopaque substance, followed immediately by roentgenography for graphic visualization of blood vessels. The substance may be injected into the artery percutaneously or following surgical exposure of the artery.

Purposes.—To determine site, size, and nature of pathologic processes of the cerebral vascular system, and to localize tumors, abscesses, aneurysms, and other lesions large enough to distort the normal cerebral vascular pattern.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for open technique is listed under setups. A supine position, with the patient's shoulders elevated, is used (Chapter 4). The neck region is cleansed and draped with towels, and the patient is draped with sheets in such a way as to expose the internal carotid artery. The closed method may be carried out in the x-ray department, or in the operating room if suitable x-ray equipment is available. The open method is always done in the operating room. A local or general anesthetic may be administered, but the latter is preferred.

Operative Procedures.—The steps and items include the following:

For Open Method.—

1. An oblique skin incision is made and extended through tissue layers covering the internal artery; the artery is exposed, and the needle is inserted into lumen of the artery under direct vision.
2. Citrate solution is injected.
3. The stopcock is closed, and a 20 ml. syringe containing a radiopaque solution (Urokon or Hypaque) is attached in place of the 20 ml. syringe which contained the citrate solution.
4. The stopcock is opened and the radiopaque solution is rapidly injected as the x-ray pictures are taken.
5. The stopcock is closed; then another syringe, which is filled with citrate solution, is attached, and this solution is injected to wash out the artery.
6. The stopcock is closed, the needle removed, and the wound closed. Dressings are applied.

Note. If x-rays are not taken in the operating room, the wound is protected with a sterile sheet and the patient is taken to the x-ray department where the test is completed. The patient then is taken back to the operating room for closure of the wound.

For Closed Method.—

1. A straight needle or curved arterial needle is attached to a 20 ml. syringe; the needle is inserted through the skin near the lower border of the sternomastoid muscle and directed upward parallel to the common carotid artery until it enters the lumen of the artery.
2. The syringe is removed and the needle connected to one end of the plastic tubing of the intravenous set which, in turn, is connected to a two-way stopcock.

Setup, Position, Skin Preparation, and Draping Procedure.—Instruments and supplies are listed under setups. The patient is placed on the operating table in a slightly reverse Trendelenburg position, with his head supported by a cerebellar crutch (Fig. 152). The posterior region of the scalp is prepared and draped with towels and the patient draped with a fenestrated sheet. (Chapters 3 and 4.)

Operative Procedure.—

Steps	*Items*
1. Small vertical incisions are made on either side and the wound edges retracted.	1. Scalpel, sponges, 2 self-mastoid retractors
2. The periosteum is freed from the skull and retracted.	2. Periosteal elevators, compresses, tissue forceps
3. The trephine openings are made, bone dust is removed and bleeding controlled (Fig. 157).	3. Hudson brace, perforator burr, electrosurgical unit bone curette, Asepto syringe, saline solution, compressed cotton pledgets
4. The same procedure is performed on the opposite side at the scratched site.	
5. The dura mater is elevated and nicked; then the underlying pia and the arachnoid membrane are incised. Bleeding is controlled.	5. Dural hook, scalpel, silver clips, dural forceps
6. The cannula-ventricular needle is inserted into the ventricle, the stylet removed, and the fluid collected (Fig. 157).	6. Ventricular needle with stylet, medicine glass, cotton pledgets
7. Step 6 is performed on the opposite side.	7. Ventricular needle, medicine glass, sponges
8. Air or oxygen is injected through the cannula of each needle and the patient's head rotated. The air enters the upper cannula as the fluid leaves the lower one.	8. 20 ml. syringe, rubber connector; fluid measured and stored in specimen bottle
9. The needles are removed and a catheter may be inserted.	9. Pledgets, catheter No. 6 F
10. The galea and skin are closed in layers.	10. Interrupted sutures, silk Nos. 2-0 and 3-0 threaded or swaged-on curved cutting-edge needles, tissue forceps, needle holders, scissors
11. The wounds are dressed.	11. Collodion, gauze compresses, gauze bandage
12. The patient is taken to the x-ray department accompanied by the surgeon and the anesthetist.	

CRANIOTOMY

Definition.—The term craniotomy usually infers the fashioning of a large opening in the skull to expose and deal with intracranial disease. Depending on the location of the pathology, the craniotomy may be frontal, parietal, occipital, subtemporal, or suboccipital (Figs. 140, 158-163).

Considerations.—The lesions demanding intracranial surgery are as numerous and varied as those demanding intra-abdominal or intrathoracic surgery. The following list of major cranial lesions which fall into the neurosurgical field does not pretend completeness but is rather a guide to indicate the more common surgical problems.

Surgical lesions of the brain and cranium may be classified as follows:

1. *Congenital*
   - Hydrocephalus: obstructive, communicating
   - Cranial meningocele
   - Arnold-Chiari malformation
   - Craniosynostosis
2. *Inflammatory*
   - Osteomyelitis of skull
   - Cerebral, cerebellar, subdural abscess
   - Granulomas
   - Parasitic cysts
   - Basilar arachnoiditis
   - Pseudotumor cerebri
3. *Traumatic*
   - Scalp wounds
   - Depressed and compound skull fractures
   - Epidural and subdural hemorrhage (Fig. 158)
   - Intracerebral hemorrhage
   - Cerebrospinal fluid rhinorrhea and otorrhea
   - Penetrating wounds of the brain
   - Skull defects
4. *Neoplastic*
   - Gliomas
   - Meningiomas and neurinomas
   - Glandular tumors
   - Miscellaneous tumors and cysts (Fig. 159)
5. *Vascular Disorders*
   - Cerebral aneurysms
   - Arteriovenous anomalies
   - Carotid-cavernous fistulas
6. *Cranial Nerve Lesions*
   - Trigeminal neuralgia (Fig. 140)
   - Glossopharyngeal tic
   - Meniere's disease
   - Acoustic neurinoma
7. *Eleptogenic Foci*
   - Cortical scars
8. *Psychoses and Basal Ganglia Diseases*
   - (Cerebral tractotomies and ablation procedures, Fig. 160)

Surgical Approach.—Cerebral lesions or those at the base of the brain are usually approached by an osteoplastic flap. The term osteoplastic indicates that the procedure is carried out with the minimal amount of disfigurement to the patient. To accomplish this, the skull plate, which is elevated in the exposure, is replaced to maintain the normal contour of the head. In performing an osteoplastic craniotomy, the bone plate may be left attached to the temporalis muscle and turned back with the soft tissues, or the plate may be separated from the soft tissues, laid aside under sterile precautions, and replaced at the completion of the intracranial surgery (Fig. 159).

3. A 20 ml. syringe, filled with normal saline solution which may be heparinized or citrated, is attached to the stopcock. All precautions are taken to prevent the formation of air bubbles in the syringe or tubing, because, if present, a cerebral air embolus will result when the solution is injected.

4. Amounts of 10 to 15 ml. each of Urokon or Hypaque are injected as x-ray pictures are taken.

5. The needle is withdrawn, firm pressure is applied for a few minutes to the site of the arterial puncture to prevent the development of a cervical hematoma.

6. A tracheostomy set should be ready for immediate use, because if extensive swelling impairs respiratory exchange, a tracheostomy tube is inserted (Chapter 7).

Sagittal Sinus Venogram

Definition.—Through an opening made in the skull, the superior sagittal sinus is opened, its draining channels outlined by means of radiopaque solution and x-ray pictures.

Purposes.—This technique is useful in determining the diagnosis of certain cerebral disorders and in determining whether the sinus is blocked by an overlying tumor.

Considerations.—It is true the brain will not stand sudden ligature of the sagittal sinus, but it will tolerate slow occlusion by a tumor. When the tumor invades the sinus, both the sinus and the tumor must be resected in order to obtain a cure, and this is only possible if the sinus is blocked.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as described for ventriculogram, adding ureteral catheter 8 F, percutaneous arteriogram, normal saline solution with heparin (10 mg. per liter), and a spinal manometer. The patient is placed in a supine position, with his head elevated. The frontal region is cleansed, and the patient is draped with a fenestrated sheet A general anesthetic is administered.

Operative Procedure.—The steps and items include the following:

1. A midline incision is placed in the frontal region and a burr hole is made directly over the superior sagittal sinus

2. A tiny incision is made in the sinus and the ureteral catheter is threaded into it (see procedure for arteriogram).

3. The catheter is attached to a manometer, and the heparinized saline solution, drawn into a syringe, is injected into the sinus by means of a three-way stopcock.

4. The wound is packed with cotton pledgets and the skin edges closed.

5. The pressure readings are taken and the radiopaque solution is injected as x-rays are taken.

6. As soon as the films have been developed and read, the wound is reopened, the catheter removed, and bleeding controlled by packing with a hemostatic substance such as Gelfoam

7. The galea and skin are closed and the wound dressed.

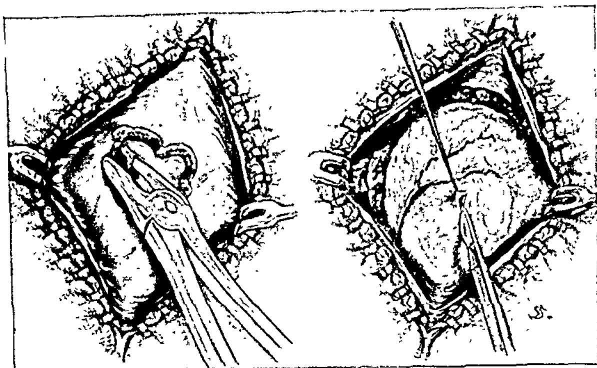


Fig 159.—*A*, Craniectomy in process. *B*, Craniectomy completed, the dura being incised. (From Sachs, E: Diagnosis and Treatment of Brain Tumor and Care of the Neurosurgical Patient, St. Louis, 1949, The C. V. Mosby Co)

Operative Procedure.—The operative steps and items include the following:

Osteoplastic Craniotomy for Removal of Cerebral Glioma

Steps	*Items*
1. Pressure is placed at site of proposed incision by assistant surgeons. The scalp is incised through the galea aponeurotica. Clips or hemostats are placed on both sides of the scalp, incorporating the galea.	1. Compresses, knife, autoclips on holder, Raney or Michel clips, 2 opened compresses or thin skin towels, tissue forceps, straight and curved hemostats
2. The scalp incision is retracted. Hemostats may be held together with gauze or an elastic band, which is fastened to drape. Bleeding vessels are coagulated.	2 Senn or Volkman retractors, sponges, straight hemostats, elastic band or sponge opened, towel forceps, electrocautery
3. Soft tissue flap is turned down subperiosteally. Bleeding is controlled.	3. Sharp periosteal raspatories and chisel, sponges, and bone wax
4 Trephine openings are made with perforator and burrs or by electric automatically disengaging drill. Bone dust removed from holes by irrigation or forceps Burr holes packed with com-	4. Hudson brace, perforator, burrs, electric drill, warm normal saline solution, Asepto syringe, suction apparatus, medicine glass, duckbill forceps for collecting and saving bone dust which may be

(Continued on page 222)

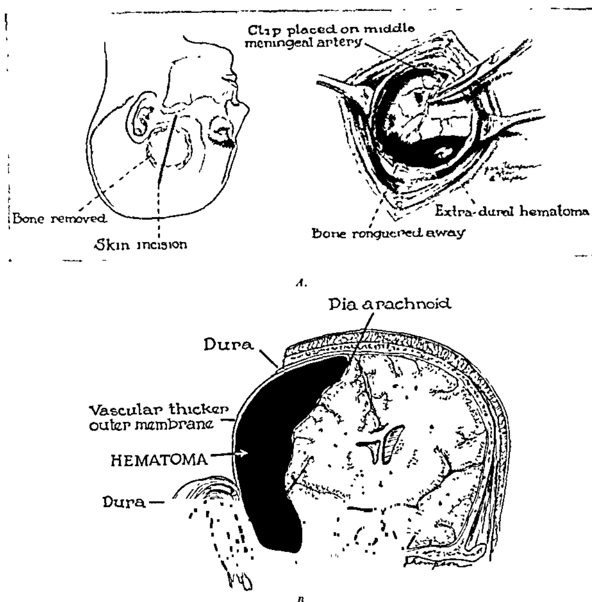


Fig 158 — *A*, Extradural hemorrhage *B*, Subdural hematoma (From Richards, V.: Surgery for General Practice, St Louis, 1956, the C. V Mosby Co)

When the bone is not replaced, a cerebral decompression results. Bony defects left by previous surgery or trauma can be corrected by cranioplasty with bone grafts from a rib, tantalum plates, or one of the newer resins.

Subtemporal and suboccipital craniotomies are, in effect, craniectomies (Fig. 163). Since they are performed under heavy layers of muscle, it is unnecessary to replace the bone, and in these locations it is more satisfactory to rongeur bone off than to make a bone flap (Figs. 159 and 160)

The instrument setup and the operative steps of an osteoplastic craniotomy for cerebral tumor and a suboccipital craniotomy for removal of a posterior fossa tumor will be described for illustrative purposes. Other common operations with their variations from the basic procedures will be indicated more briefly

Setup, Position, Skin Preparation, and Draping Procedure.—As described previously under listing of setups and preparation of the patient.

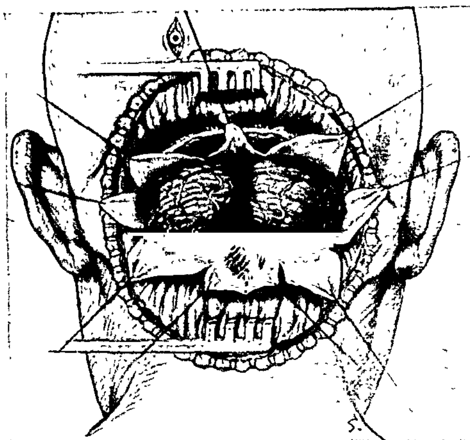


Fig. 160 C.—*For legend, see opposite page.*

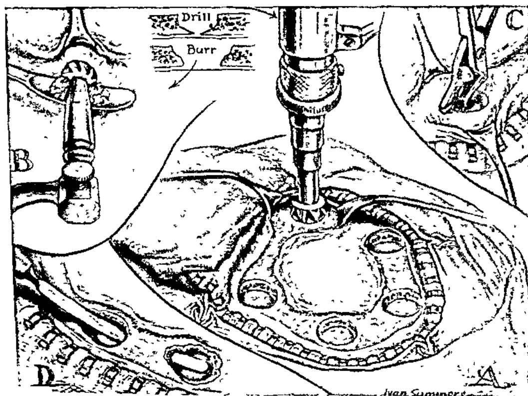
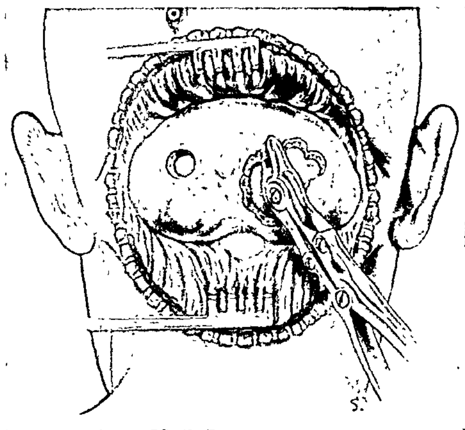


Fig. 161.—Instruments and method of making an osteoplastic flap. (From Sachs, E.: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St. Louis, 1919, The C. V. Mosby Co.)

A



B

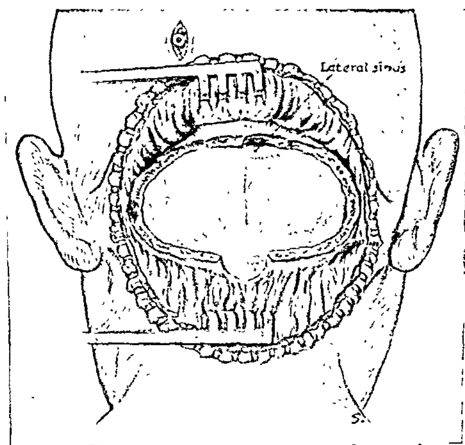


Fig 160—Suboccipital craniotomy. *A*, Craniotomy being performed. *B*, Dura exposed, *C*, Dura incised and cerebellum exposed (From Sachs, E: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St Louis, 1949, The C. V. Mosby Co)

Steps	*Items*
12. The brain is inspected and the tumor is removed by one of several methods. Soft gliomas are scooped and sucked out, meningiomas are isolated by gentle separation from surrounding brain and removed piecemeal or together, and others may be removed by a combination of methods. Bleeding from tumor bed is controlled by coagulation, silver clips, gently packing with warm, wet, raw or compressed cotton, irrigating with warm saline solution or applying a hemostatic substance, or muscle stamps.	12. Brain retractors, spatula, ganglion light retractors, brain scoops, hypophyseal and alligator pituitary forceps, tumor forceps, Adson suction tips (Fig. 152); spinal needle and syringe for evacuation of a cyst, hemostats and swaged-on taper-point, curved needles with silk sutures Nos. 4-0 and 5-0 for traction sutures, hemostatic substance, Asepto syringe, warm saline solution, cotton patties and loose cotton balls
13. After the exploration is comcompleted, the lesion removed, and the bleeding controlled, the dura is closed with interrupted sutures placed closely together (Figs. 162 and 163).	13. Silk No. 4-0 or 5-0, dural sutures swaged-on small, curved taper-point needles, needle holders, tissue forceps, scissors
14. The bone flap and skull edges are perforated with spiral drill for insertion of stainless steel wire or silk sutures. A suture may be placed in the dura, drawn through the drilled opening in the bone flap to prevent collection of extradural blood.	14. McKenzie drill, Adson drill guide to protect dura, skull punch, silk No. 2-0 swaged-on curved, taper-point needle, or stainless steel wire, if desired, hemostats
15. The bone flap is replaced, and sutures are tied. Bone dust may be replaced in burr holes, or tantalum shields may be used to cover the holes. A drain may be inserted.	15. Wire scissors, Penrose or cigaret drain
16 The galea aponeurotica is closed with interrupted sutures.	16. Chromic gut No. 2-0, or silk No. 3-0, 12-inch lengths, threaded or swaged-on Mayo-Murphy curved, taper-point needles No. 2
17. The epithelial edges are carefully approximated and sutured.	17. Silk No. 4-0 threaded or swaged-on fine, straight needles
18. The cranial wound may be covered with a cotton and collodion dressing and a few layers of fine-mesh gauze. A crinoline dressing is applied wet and painted with starch paste, or held in place with a roller.	18 Thin, raw cotton strips, collodion, crinoline helmet or fine-mesh gauze fluffs, cotton elastic bandage; starch paste

Steps	Items
pressed cotton pledgets or bone wax for hemostasis Suction and saline solution are required when using the electric drill (Fig. 161).	later replaced in the burr holes, cotton pledgets, bone wax
5. The dura is separated from the inner surface of the bone, freeing the dura around the perforator opening. The burr holes are beveled (Figs 160*A* and 161).	5. Curved, fine dissector, elevators, Adson cranial rongeur, bone wax
6 The Gigli saw guide and conductor are passed between the two openings to protect the dura; then the Gigli saw is pulled through, thus cutting the bone on a bevel.	6. Gigli guide and conductor, Gigli saw and holders, warm saline solution, Asepto syringe, suction set
7. After the bone on either side of the base leg has been sawed, the bone of the base flap is fractured. The direction of the fracture of the flap is determined by a cut with the rongeur.	7. Hudson or DeVilbiss cranial rongeur, wet cotton pledgets and strips
8. The bone flap is elevated and cracked backward along the rongeur cut (Fig. 162).	8. Periosteal elevator, cotton pledgets
9. The scalp and the bone flap are reflected backward and covered with a towel, bleeding is controlled. The dura is covered with cotton pledgets and strips. Operative field is cleaned.	9. Electrosurgical unit, bone wax, compressed cotton strips; if bone plate removed, wrapped in sterile towel for replacement later; wet compresses opened and placed over the flap, straight hemostats used to fasten the flap to the drape; clean towels for placing around the wound
10. The dura is grasped, lifted up, and nicked, its opening is enlarged in the direction of the dural flap The dural flap is reflected generally with its base toward the midline. Edges of the dura are sutured to the adjacent soft tissues. Bleeding is controlled. (Figs 160 to 163.)	10. Dural hook, ureteral knife or scalpel with blade No. 11, flexible brain spoon or grooved director, scalpel with blade No. 10, dural scissors, Adson suction tips, cotton sponges, tissue forceps, electrosurgical unit, Mayo-Kelly hemostats, silver clips, silk sutures No. 3-0 for dural bleeding
11. A ventricle tap may be performed to reduce the intracranial pressure or to tap or evacuate a cyst in the brain, thus allowing the dura to be opened without danger of a rupture or cortical herniation (Figs. 157 and 160,*A*).	11. Scalpel with blade No. 11, brain cannula needle, 20 ml. syringe, adaptor, rubber connector for aspiration, specimen tube (Fig. 152)

For Subtemporal Craniotomy.—The steps and items are similar to osteoplastic craniotomy.

The patient is placed on the operating table in the supine position, with the head rotated to the opposite side; or he may be placed in a sitting position with the head supported.

A vertical incision about 5 cm. long is made from a point over the zygoma, one fingerbreadth anterior to the ear. The temporal muscle is split in line with its fibers and retracted with self-retaining mastoid retractors. (Fig. 163.) A window is made in the temporal bone with a perforator and burr and enlarged with rongeurs to the size of a silver dollar, similar to Step 4 in procedure for removal of cerebral glioma.

To approach the origin of the middle meningeal artery at the foramen spinosum and the gasserian ganglion of the fifth nerve, the dura is swept off the floor of the middle fossa. The artery is coagulated and divided, the ganglion exposed (Fig. 163), and the nerve root divided. When all bleeding is controlled, closure is effected with interrupted silk sutures for the deep fascia, galea, and skin. If the procedure is intended for the evacuation of a subdural hematoma or as a decompression operation, the dura is widely opened in stellate fashion to expose the underlying brain (Fig. 158).

OPERATIONS ON THE PITUITARY GLAND

Definition.—The surgery of the pituitary is directed toward removal of neoplasms, which in their growth press upon the optic nerves, causing visual field defects and blindness.

Considerations.—A careful intracapsular removal of the tumor is performed by gentle curettage and suction until the optic nerves are completely decompressed. Usually, the surgery is followed by a course of x-ray therapy to thwart recurrence of the growth.

A hypophysectomy is the total excision of the pituitary gland. This procedure has been found to benefit about 50 per cent of patients who have extensive metastatic carcinoma of the breast. The rationale of the procedure is that in about half the cases of mammary carcinoma the growth of the tumor is dependent on certain hormones controlled by the pituitary. When the latter is removed, activity of the tumor ceases, and the metastases may even regress.[4,6,9,14]

Setup, Position, Skin Preparation, and Draping Procedure.—(1) For pituitary operations, as described for standard osteoplastic craniotomy, adding pituitary scoops and various ring curettes; Adson forceps curved and straight, 7¼ inches long; Bailey or Love hematome. (2) For aneurysm operations, as described for standard osteoplastic craniotomy, adding large Olivecrona clips and holders. (3) For spinal drainage, spinal puncture setup.

Operative Procedure.—The steps include the following:

1. The pituitary is approached through either a straight frontal craniotomy along the floor of the frontal fossa immediately adjacent to the falx, or through a more lateral incision along the sphenoid ridge. In the former, a coronal incision keeps the scar behind the hair line, and a right frontal bone flap is turned

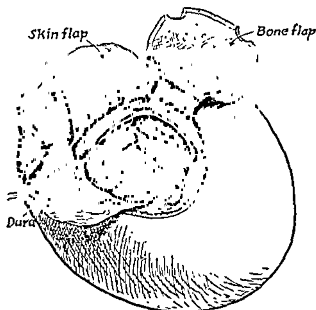


Fig. 162.—The scalp, bone, and dural flaps are shown as in a craniectomy. (From Sachs, E.: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St. Louis, 1949, The C. V. Mosby Co.)

Fig. 163.—A craniectomy with a subtemporal compression. (From Sachs, E.: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St. Louis, 1949, the C. V. Mosby Co.)

Operative Procedure.—For treating a depressed skull fracture in an infant, it is a simple matter to make a small opening in the skull adjacent to the depression, insert a staphylorrhaphy between the dura and depressed bone, and raise the latter up into its normal position. In adults, it is usually necessary to remove the fractured pieces and fit them back in place, or if they are contaminated, to remove them completely.

If damage to underlying brain is suspected, the dura is incised, and the cortex examined and débrided, if indicated.

Various inert, nonirritating substances are used to replace the missing bone. Tantalum plates are cut to fit and shaped according to the contour of the normal skull, or rib grafts, or resin material (Cranioplastic) is molded into the desired shape, using aseptic techniques. In performing a cranioplasty, the soft tissue flap is turned down, preserving the underlying dura and exposing the cranial defect. It may be necessary to freshen and trim the bone edges to receive the prosthesis, which is fashioned to make a snug fit. It is affixed with silk or wire sutures placed through drill holes in the adjacent bone.

SUBOCCIPITAL OR POSTERIOR FOSSA CRANIOTOMY

Definition.—The perforation of the occipital bone, exposure of the foramen magnum and arch of the atlas, and removal of lesion in the posterior fossa. Depending upon the type and size of the lesion, the exposure may be unilateral or bilateral, and often the operation may include removal of the arch of the atlas.

Purpose.—A suboccipital craniotomy is done to remove lesions of the posterior fossa.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for osteoplastic craniotomy except omit bone flap setup and add two Hudson braces, cerebellar extension for Hudson brace, and perforating burrs for electric-driven drill. The patient may be placed in a sitting position, with aid of a headrest, or in an Adson chair; or in a prone position, using the cerebellar frame, or placed on the unaffected side for a unilateral approach. The position will depend on the preference of the surgeon and the kind of operation to be done

Surgical Approach.—A wide exposure, obtained by the classical "T" incision of Cushing, is useful for exposing large tumors and lesions of the fourth ventricle which cause increased intracranial pressure where a sizable decompression is necessary. The unilateral horseshoe or straight incision usually suffices for sectioning cranial nerves or for removing acoustic neurinomas.

Operative Procedure.—The steps and items include the following:

Wide Suboccipital Craniotomy for Removal of a Cerebellar Tumor

Steps	*Items*
1. The patient is prepared, the skin incision is made. Bleeding is controlled by manual pressure, ligation, or coagulation.	1. Gauze and cotton compresses, knife, skin clips, tissue forceps, straight and curved hemostats, electrosurgical unit

down similar to the procedure for an osteoplastic flap. The approach along the sphenoid ridge is made through a horseshoe-shaped incision in the frontotemporal area. The frontal approach is employed for repairing cerebrospinal fistulas in the nose and for decompressing the orbits in malignant exophthalmos. In the latter instances, the dura is not opened but is stripped off the inner aspect of the skull intact.

2. The dura may be opened, depending on the situation.

3. The spinal fluid is withdrawn through a previously placed indwelling spinal needle, as the frontal lobe is elevated to expose the region of the optic chiasm.

INTRACRANIAL ANEURYSMS

Definition.—"An aneurysm is the dilatation of an artery full of spirituous blood."[21]

Intracranial aneursysms most commonly occur about the circle of Willis or along its major branches. Their rupture results in subarachnoid hemorrhage, serious neurologic disorders, and often death. Surgical procedures are designed toward obliterating the aneurysms, strengthening their weakened walls, or lessening the force of blood flow to the lesion by ligation of feeding vessels. Often simple carotid ligation in the neck with silk or a special clamp (Selverstone) is all than can be safely performed.

When an intracranial approach is indicated it is often expedited by using one of the hypothermia techniques, cooling the patient prior to surgery in an ice bath or refrigeration blankets, and placing temporary ligatures around the cervical carotids which may be drawn tight as surgical necessity dictates.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for pituitary surgery, plus large Olivecrona clips and holders and double suction apparatus.

If preliminary cervical carotid ligation is indicated, a separate setup as described for open arteriography or superior cervical sympathectomy is used.

Operative Procedure.—The circle of Willis is approached in a manner similar to surgery on the pituitary gland. If hypothermia is contemplated, the nurse should familiarize herself with the technique to be used by prior consultation with the anesthetist and surgeon and be prepared accordingly.

DEPRESSED SKULL FRACTURES AND CRANIOPLASTY

Definition.—The elevation or removal of a fractured piece of the skull, and implantation of a prosthesis, if necessary

Purposes.—Depressed skull fractures are elevated to prevent the later development of epilepsy from localized pressure scarring of the brain, or for cosmetic reasons, and, in the case of compound fracture, to convert a contaminated wound into a clean one. A cranioplasty is done to repair a cranial defect.

Setup, Position, Skin Preparation, and Draping Procedure.—As for craniotomy, adding tantalum plates, mallet concave and convex lead molds, metal files, drill and drill points, tantalum wire sutures, or resin material. Routine skin preparation and draping procedure as for neurosurgery are carried out.

For Prefrontal Lobotomy.—Setup and procedure have been previously described for operations of the pituitary gland.

VENTRICULOCISTERNOSTOMY

(Torkilsen Procedure)

Definition.—A small rubber catheter is passed from a lateral ventricle into the cisterna magna, thus by-passing the obstruction of cerebrospinal fluid circulation.

Purpose.—When an inoperable lesion obstructs the aqueduct or fourth ventricle, a shunting procedure may be indicated to relieve the increased intracranial pressure.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for posterior fossa craniotomy, including dura setup and Hudson brace with large perforating burrs, laminectomy chisels, Adson drainage cannulas, catheters Nos. 8, 10, and 12 F, or polyethylene tubing of suitable sizes.

Operative Procedure.—The major steps and items are similar to those described for posterior fossa craniotomy.

1. A midline suboccipital incision is made and carried upward to one occipital region.

2. A small suboccipital craniectomy is performed to expose the cisterna magna, and occasionally the arch of the atlas is also removed.

3. A burr hole is placed in the occipital region and the rubber catheter inserted into the dilated lateral ventricle. The other end of the catheter is placed below the arachnoid of the cisterna magna. A groove is sometimes cut in the bone along the course of the tube so that it may lie directly on the dura.

4. Closure is similar to that described for posterior fossa craniotomy (Fig. 164).

LAMINECTOMY

Definition.—Removal of one or more of the vertebral laminas to expose the spinal cord or its adjacent structures, and to remove the lesion. The approach and kind of operation to be performed depends on the probable pathology present.

Purposes.—A laminectomy, hemilaminectomy, or interlaminar approach is used to treat a lesion of the spinal cord, including a herniated intervertebral disc. (Figs. 167 and 168.)

Setup, Position, Skin Preparation, and Draping Procedure.—Basic setup for spinal cord surgery is used. Instruments and draping sheets must be of an appropriate size to suit the size of the patient and to provide for exposure of the operative site

Basic principles of positioning and preparing the patient have been discussed previously in this chapter and in Chapters 3 and 4.

Steps	*Items*
2. Muscle is split down to midline to expose foramen magnum and arch of the atlas. Retractors are placed in wound.	2. Mayo scissors, electrosurgical unit, self-retaining retractors, suction set
3. Muscles are divided transversely just below insertion on occiput.	3. Sharp periosteal elevators, knife
4. Soft tissue flaps are turned down subperiosteally and held retracted. Arch of atlas is fully exposed.	4. Periosteal elevators, retractors, 2-0 silk traction sutures
5. Occipital bone is perforated and suboccipital craniectomy performed with rongeurs. Arch of atlas is removed. Bone bleeding is controlled. (Fig. 160.)	5. Hudson brace, perforator, burr, pointed gooseneck rongeurs, Kerrison punch, bone wax, Asepto syringes, normal saline or Ringer's solution
6. Burr hole is placed in posterior parietal region. Catheter is inserted into lateral ventricle to relieve increased intracranial pressure.	6. Scalpels (blades Nos. 20 and 15), mastoid retractor, Hudson brace, perforator and burr, dural hook, ventricular needle, rubber catheter No. 8 F, compressed cotton patties, silk suture No. 3-0, needle holders, tissue forceps
7. Dura is opened over cerebellar hemispheres (Fig. 161). Occipital sinus is clamped and ligated. Dura is sutured back to overlying tissues.	7. Dura hook, and scalpel, grooved director, fine tissue forceps, Metzenbaum scissors, mosquito clamps, silk No. 3-0 threaded on small curved needles
8. Posterior fossa is explored, tumor identified, and cyst aspirated.	8. Brain retractors, long damp cotton strips, metal suction tip attached to separate suction apparatus, dissecting staphylorraphies, 10 ml. springe, spinal needle gauge 20, ventricular needle
9. Tumor is removed and bleeding controlled.	9. Tumor forceps, pituitary rongeurs and scoops, cotton pledgets secured to strings, silver clips and clip holders, wet cotton balls
10. Muscles and fascia are resutured.	10. Silk No. 2-0 threaded or swaged-on curved needles
11. Galea and skin are approximated.	11. Silk No. 3-0 threaded or swaged-on curved and straight needles (as for craniotomy, Step 16)
12. Ventricular catheter is removed, and burr hole incision closed.	12. As for craniotomy, Step 16
13. Dressings and head bandage are applied.	13. Cotton, collodion, gauze neck roll, tincture of benzoin, long 4-inch adhesive

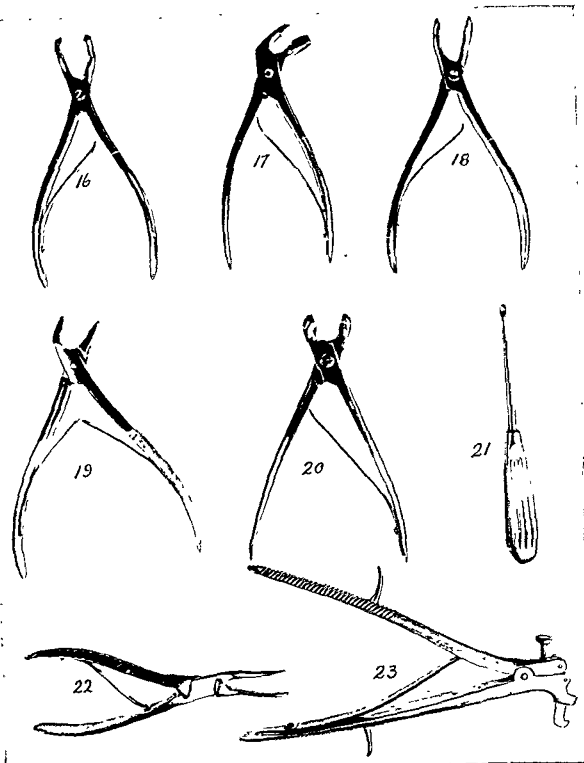


Fig 165—Instruments for spinal fusion and laminectomy—cont'd *16*, Markwalder bone-cutting forceps; *17*, Barnhill angular mastoid bone-cutting forceps, *18*, Luer rongeur forceps; *19*, Bacon mastoid rongeur forceps; *20*, Luer heavy rongeur forceps, *21*, curette, *22*, long-angled rongeur forceps; *23*, Hudson bone forceps.

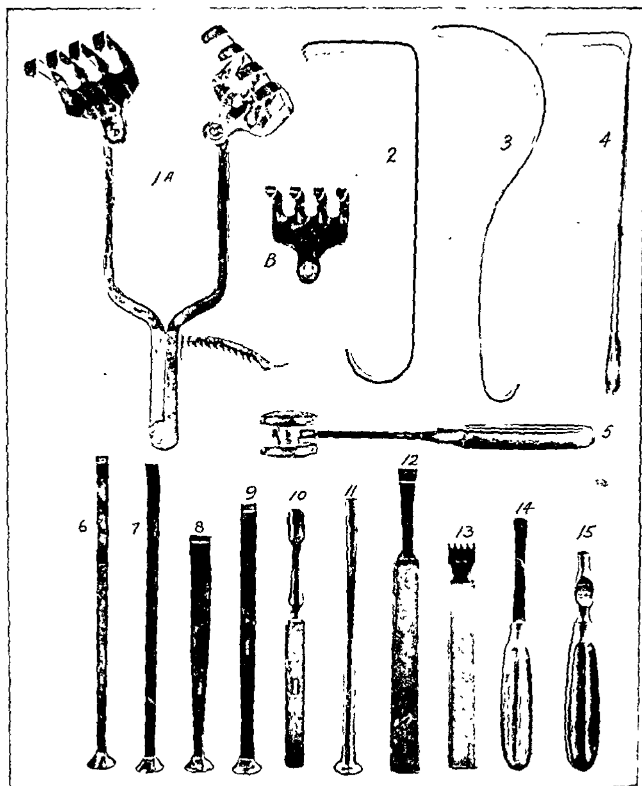


Fig 164.—Instruments for spinal fusion and laminectomy *1*, Frazier adjustable blade retractor, *2*, Hibbs retractor, *3*, Deaver retractor, *4*, Lange retractor, *5*, hammer; *6*, angled chisel, *7*, angled osteotome; *8*, angled wide chisel, *9*, angled wide osteotome, *10*, Brun straight gouge, *11*, narrow bone gouge; *12*, long-handled chisel, *13*, raspatory, *14*, periosteal raspatory; *15*, Kirmisson raspatory.

Operative Procedure.—The steps and items, as illustrated in Figs. 164 to 168, include the following:

Steps	*Items*
1. The skin is prepared and the proposed site of incision is scratched. Sterile towels and sheets are applied and towels sutured to the skin.	1. Towels and sheets, towel clips, silk No. 2-0 threaded on ⅜-circle cutting-edge needles
2. The incision is made through the skin and subcutaneous tissue. Bleeding is controlled.	2. Scalpel, sponges, curved hemostats, tissue, forceps, electrosurgical unit, suction set
3. The deep fascia is incised; the paraspinal muscles are stripped off subperiosteally and retracted.	3. Broad periosteal elevators, Mayo scissors, self-retaining retractor
4. The spinous processes and laminas are removed (Fig. 167).	4. Spine cutters, pointed and gooseneck rongeurs, Kerrison punch, bone curettes, bone wax
5. The dura is exposed and incised; the dural edges are sutured to the muscles for retraction (Fig. 168).	5. Dissecting staphylorraphies, dural hook, long-handled scalpel (blade No. 15), grooved director, compressed cotton strips, silk No. 3-0 threaded on fine, full-curved needles, long needle holders, long forceps and scissors
6. The tumor is dissected free and removed; the dentate ligaments and posterior roots may be divided for better exposure.	6. Straight mosquito clamps, endothermy forceps, Metzenbaum scissors, McKenzie brain clips and clip holders, pituitary rongeurs and scoops, catheter No. 8 F
7. The wound is irrigated; watertight dural closure is performed.	7. Asepto syringes, continuous silk No. 3-0 sutures for dural closure
8. The paraspinal muscles, deep fascia, subcutaneous tissue, and skin are reapproximated. Dressings are applied (Fig. 168).	8. For paraspinal muscles—silk No. 2-0 or chromic surgical gut threaded on Mayo needles; for muscle and fascia—silk No. 3-0; for subcutaneous layer—plain surgical gut No. 0; for the skin—silk No. 3-0; cotton and collodion dressing, gauze, compresses, tape

Operative Procedure for Extirpation of Lumbar Disc.—The steps and items, as shown in Figs. 164 to 169, include the following:

Steps	*Items*
1 through 3. Skin preparation and incision as for laminectomy.	1 through 3. As for laminectomy
4. The ligamentum flavum is excised from the interlaminar space.	4. Long-handled scalpel (blade No. 15), tissue forceps, straight hemostats, cotton pledgets, bone curettes

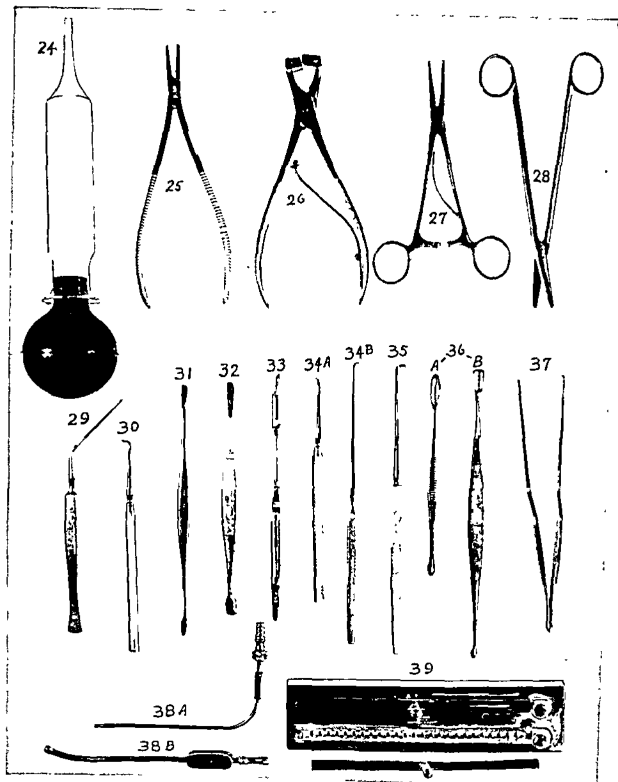


Fig 166—Laminectomy instruments—cont'd *24,* Asepto syringe; *25,* needle holder; *26,* silver wire clip cutter; *27,* forceps for holding and applying silver clips; *28,* Metzenbaum scissors, *29,* angled elevator; *30,* short dura hook, *31,* nerve separator and dissector; *32,* Adson double-end separator; *33,* Bard-Parker knife No 7 with blade No 15; *34A and B, sharp dura hooks; 35,* nerve dissector; *36A* and *B,* curettes; *37,* bayonet tissue forceps; *38A* and *B,* antrum suction tips; *39,* silver clip carrier, McKenzie modification

Note: When a spinal fusion is to be combined with excision of a herniated lumbar disc, additional bone instruments are necessary (Chapter 17). A laminectomy setup is used to perform a decompressive laminectomy for metastatic neoplasms or fracture dislocations, cordotomy, rhizotomy, excision of herniated cervical discs, and subarachnoid ureteral or subarachnoid peritoneal shunts.

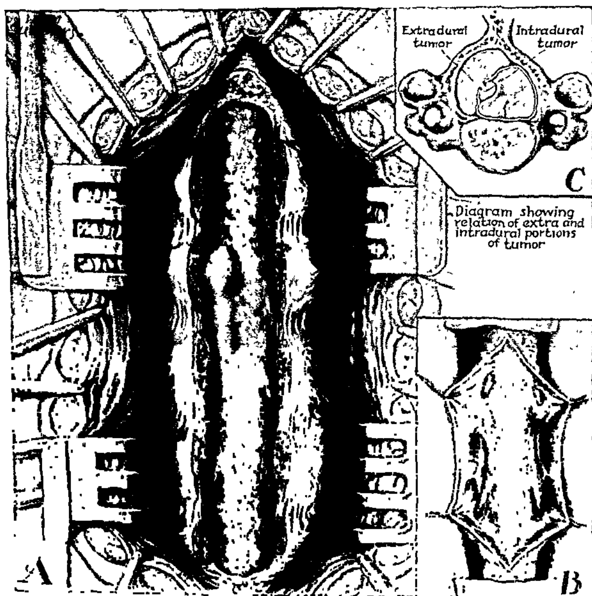


Fig. 168.—*A*, Laminectomy completed, showing the dura and a tumor exposed. *B*, The dura has been incised and retracted, showing the spinal cord covered by the pia arachnoid and a portion of the tumor area. *C*, Cross section of the tumor area. (From Sachs, E.: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St. Louis, 1949, The C. V. Mosby Co.)

Steps	*Items*
5. The interlaminar space is widened by partial removal of adjacent laminas (Fig. 168).	5. Kerrison punches, pointed rongeurs, bone wax
6. The dura and nerve root are retracted medially; the annulus fibrosis is incised.	6. Staphylorrhaphies, small glass suction tip
7. The intervertebral space is cleaned of degenerated disc material; the wound is irrigated (Fig 169).	7. Pituitary or intervertebral disc rongeurs, small bone curettes, Asepto syringes (Fig. 166)
8. The wound is closed.	8. As for laminectomy, Steps 7 and 8

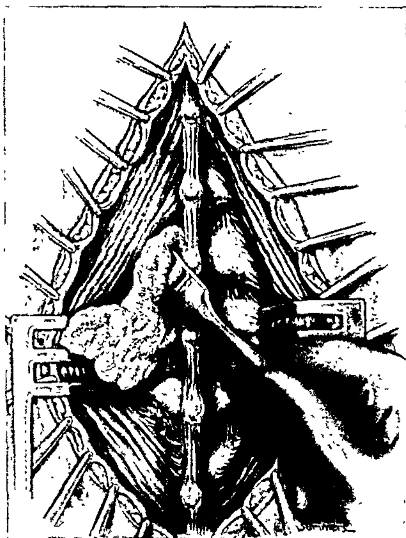


Fig 167—Laminectomy. Exposing the vertebras by dissecting the muscles away from the spine. (From Sachs, E: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St Louis, 1949, The C. V Mosby Co)

SYMPATHECTOMY

Definition.—The excision of a portion of the sympathetic division of the autonomic nervous system. Most sympathectomies are performed on the paravertebral chain and are named for the region resected; for example, cervical, thoracolumbar, and lumbar. The periarterial sympathectomy, vagotomy, and presacral neurectomy are other procedures which are occasionally applied to the autonomic system.

Purposes.—The diseases for which sympathectomy is beneficial have been suggested in the preceding section on the autonomic nervous system and its function. The prinicipal diseases with surgery are vascular disorders of the extremities, hypertension, severe angina pectoris, and intractable pain from certain chronic abdominal conditions.

Upper Cervical Sympathectomy

Definition.—Removal of the superior cervical ganglion and its connections.

Purposes.—An upper cervical sympathectomy is done to increase the blood supply through the ophthalmic artery in the patient with internal carotid thrombosis, and to produce a Horner's syndrome, which is valuable in protecting the eye after a facial paralysis, because of the ptosis produced.

Setup, Position, Skin Preparation, and Draping Procedure.—As described under neurosurgical setups and preparation of the patient. The principles of positioning a patient in a supine position, with the head turned slightly to the opposite side and the neck extended, have been described in Chapter 4. A thyroid or neck pack may be used for draping the patient (Chapter 7).

Operative Procedure.—The major steps include the following:

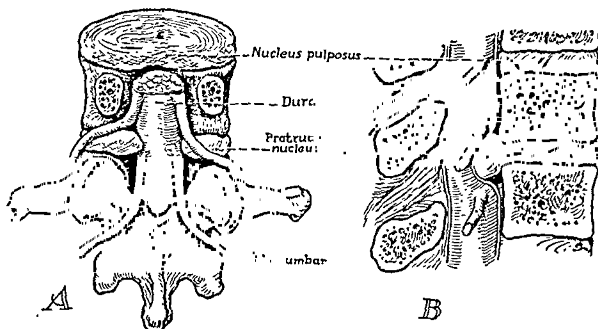
1. After infiltration of a local anesthetic, a short oblique incision is made below the angle of the jaw.
2. The incision is deepened through the platysma and cervical fascia; the sternomastoid muscle is retracted laterally and the carotid sheath is exposed.
3. The carotid artery and jugular vein are retracted laterally, and the superior cervical ganglion is isolated just below the base of the skull.
4. The ganglion is elevated on a nerve hook and removed after its many connections have been severed. The wound is closed as for laminectomy.

Cervicothoracic Sympathectomy

Definition.—Removal of the cervicothoracic chain, usually from the middle cervical to the third thoracic ganglion

Purpose.—Sympathetic denervation of the upper extremity and heart is accomplished by this procedure. The vasospastic phenomenon of Raynaud's disease also is relieved by this procedure and it may be beneficial in relieving intractable angina pectoris.

Setup, Position, Skin Preparation, and Draping Procedure.— (1) Anterior approach—as for cervical sympathectomy, adding deep retractors and stimulator. (2) Posterior approach—as for cervical sympathectomy, adding rib-cutting in-



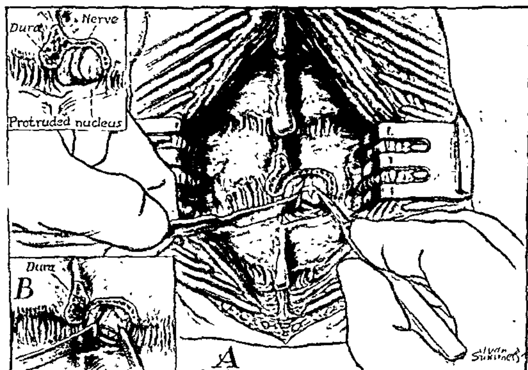


Fig 169—Herniation of lumbar intervertebral disc (From Sachs, E: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St Louis, 1949, The C. V. Mosby Co)

Setup, Position, Skin Preparation, Draping Procedure.—As in posterior cervicothoracic sympathectomy, adding Adson splanchnic retractors with light attachments, two ganglion light cords and batteries, Adson long forceps, nerve hooks and knives.

The patient may be placed in a prone position, with his face resting in the cerebellum headrest and his shoulders slightly elevated; or he may be placed in a lateral decubitus position. Regular fenestrated sheets are used (Chapter 4).

Surgical Approach.—The operation is carried out bilaterally, usually in two stages, ten days apart. A retropleural or retroperitoneal approach is generally employed, although a transpleural or transdiaphragmatic exposure is preferred by some surgeons (Chapters 9 and 11). The classical Smithwick procedure will be described.

Operative Procedure (Smithwick Technique).—The steps include the following:

1. The patient is placed in the lateral decubitus position over the elevated kidney rack (Chapter 16); a paravertebral incision is made downward from the ninth rib and curved anteriorly toward the iliac crest.
2. The latissimus dorsi is divided in line with the skin incision, and the sacrospinalis is retracted medially to expose the eleventh and twelfth ribs (Chapter 9). These two ribs are resected superiosteally, leaving the intercostal neurovascular bundle intact.
3. The pleura is gently stripped off both the inner chest wall and the diaphragm by blunt dissection. The renal fascia is incised, and the retroperitoneal space is opened and enlarged to expose the undersurface of the diaphragm. The latter structure is divided down to its attachment to the vertebral bodies.
4. The greater splanchnic nerve is dissected out with staphylorraphies at the level it pierces the diaphragm. The nerve is divided as it enters the celiac plexus. It is then traced upward to the ninth rib and avulsed.
5. The sympathetic chain is similarly dissected out and traced upward, clipping each ramus in turn with silver clips; then it is divided. Attention is directed to removing the lower sympathetics from the diaphragm down to the third lumbar.
6. When all bleeding has been controlled, a large, firm rubber tube is placed in the retropleural space and the wound closed. A purse-string suture, which is placed around the exit of the tube, is tightened. Suction apparatus is applied to the tube to remove any remaining air in the retropleural space, and the tube is rapidly removed as the purse-string suture is tied down.
7. If the pleura has been opened during the operation, an indwelling chest tube may be inserted into the chest cavity and connected to an underwater-seal drainage set (Chapter 9).

Lumbar Sympathectomy

Definition.—The denervation of the lower extremities.

Purpose.—Lumbar sympathectomy is useful in treating such vasospastic disorders as Buerger's disease, and some selected cases of vascular insufficiency sec-

struments, periosteal elevators, small rib retractors, firm rubber pad and operating table attachments for posterolateral position, and thoracoplasty pack (Chapter 9).

Operative Procedure.—

For Anterior Approach.—The steps include the following:

1. The patient is placed in a supine position and the head rotated to the opposit side as in mastoidectomy (Chapter 7). General endotracheal anesthesia is necessary as there is always a possibility of puncturing the pleura.
2. A transverse incision is made one fingerbreadth above the clavicle; the clavicular head of the sternomastoid muscle is severed; the deep cervical fascia is divided.
3. The phrenic nerve and the jugular vein are protected, and the anterior scalene muscle is divided to expose the underlying subclavian artery (Fig. 171). This vessel is isolated, and the thyroid axis, which is one of its branches, is ligated and divided.
4. The stellate ganglion lying deep against the verterbral body then is brought into view, and it is lifed on a nerve hook. The sympathetic chain is traced upward to the middle cervical ganglion and divided. Deep dissection behind the pleura allows exposure of the upper thoracic ganglia, which are removed to below the third.
5. The wound is closed with silk sutures and without drainage.

For Posterior Approach.—The steps include the following:

1. The paravertebral incision is centered over the third rib. The trapezius muscle is divided and the rhomboid split in line with its fibers (Chapter 9). The third and fourth ribs are isolated extrapleurally and the posterior 4 or 5 cm are resected. The transverse processes may be removed, using a rongeur to provide for better exposure.
2. The sympathetic trunk, which lies on the anterolateral aspect of the vertebral body, is reached by carefully reflecting the pleura. The trunk is picked up on a nerve hook, traced up and down, and removed, usually from the stellate ganglion to the fourth thoracic.
3. A firm rubber tube is left in the wound during closure. Suctioning apparatus is applied to this tube as the last deep fascial suture is drawn tight; all air is aspirated and the tube quickly withdrawn (Chapter 9).
4. The subcutaneous tissue and skin edges are closed.

Thoracolumbar Sympathectomy and Splanchnicectomy

Definition.—Through a paravertebral incision the greater splanchnic nerve is dissected, and lower sympathetics from the diaphragm down to the third lumbar are removed (Smithwick).

Purposes.—This extensive procedure, which denervates the majority of the viscera, reduces vascular tone over such a large area that the blood pressure is markedly reduced. It has proved successful in the treatment of essential hypertension. A more limited resection is used occasionally to interrupt the visceral pain pathways from the upper abdomen and to relieve the intractable pain involving the biliary tract.

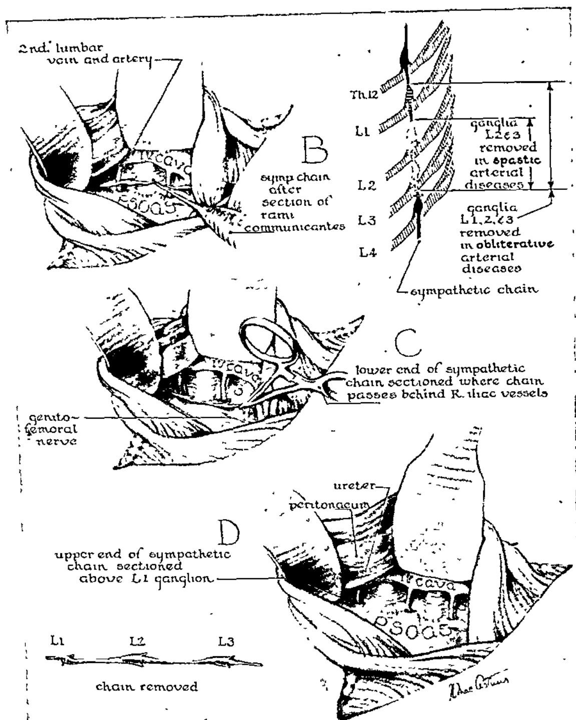


Fig. 170 (cont'd)—*For legend, see opposite page.*

SURGERY OF PERIPHERAL NERVES

Definition.—Suturing the divided nerve with precise approximation without tension.

Considerations.—Peripheral nerve injuries are the commonest indication for surgery of these structures.[8,12,15,17] Nerve tumors are rare in comparison. During wartime, injuries of nerves assume particular importance because of their frequency and disabling sequelae. (Chapter 17.)

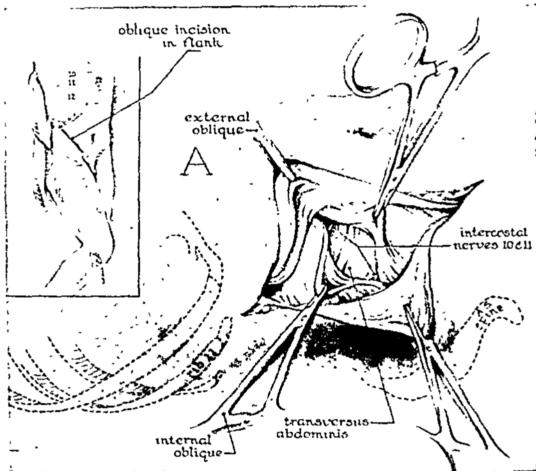


Fig 170.—Lumbar sympathectomy. (From Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C V. Mosby Co)

ondary to peripheral arteriosclerosis. It may also be of benefit in combatting excessive sweating of the feet.

Setup, Position, Skin Preparation, and Draping Procedure.—As in thoracolumbar sympathectomy, except fewer rib-cutting instruments are required. The patient may be placed in a supine position if an anterior approach is to be used, or in a lateral position for a posterolateral incision. (See kidney position, Chapter 16.) Laparotomy or pneumonectomy fenestrated sheets (Chapter 9), or orthopedic sheets, (Chapter 17) are used.

Operative Procedure.—The steps, as shown in Fig. 170, include the following:

1. Lumbar sympathectomy may be done transperitoneally or retroperitoneally, but the latter is more commonly used. A long McBurney-type incision or a straight or curved flank incision is employed

2. The muscles are split in line with their fibers or portions are divided to expose the retroperitoneal space.

3. The sympathetic chain is picked up on a long nerve hook and resected from above the second to below the third lumbar ganglion, clipping the rami as in a thoracolumbar sympathectomy. Adequate deep retractors usually are necessary for adequate exposure; care is taken not to tear the lumbar veins which lie over the nerves.

4. The wound is closed in layers and dressed as for hernial repair.

For lesser procedures, such as spinofacial anastomosis in the neck, division of the volar carpal ligament for median nerve compression at the wrist, or repair of a small digital nerve, suitable modification may be made.

The position and draping of the patient with sheets depend upon the site of the injury. Repair of digital nerves is described in Chapter 17.

Operative Procedure.—The major steps of repair of peripheral nerves include the following:

1. General anesthesia is usually preferred, with the patient positioned for maximum accessibility to the injured nerve (Chapter 4). Exposure must be adequate, as often considerable mobilization of the nerve is necessary.

2. The site of injury is explored with careful attention to hemostasis. Nerve ends are dissected out from surrounding scar tissue and neuromas excised (Fig. 171). The nerve repair is made with multiple fine sutures placed only through the nerve sheath or epineurium. Tension at the suture line is eliminated by such maneuvers as slight stretching of the nerve, transposition of the nerve so as to shorten its course, and occasionally by a nerve graft, by appropriate positioning of the extremity and by plaster splinting during the postoperative period. (Chapter 17.)

IMMEDIATE POSTOPERATIVE CARE OF PATIENTS

The immediate postoperative care of neurosurgical patients is best carried out in a suitably equipped recovery room situated near the operating suite, and by an expert understanding nursing staff under the medical direction of the surgeon and anesthesiologist.

Intracranial Operations.—The most important immediate postoperative concern for the craniotomy patient is the status of his respirations and the freedom of his airway. Any obstruction of the airway will cause straining and coughing, which precipitously increase intracranial venous pressure, and may result in hemorrhage.

An endotracheal tube, if still in place, must be kept clear and should be removed promptly when it becomes apparent that the patient has reacted. An oral airway is inserted and judicious suctioning performed.

When a tracheotomy has been done, the tube must be kept free of secretions and the inner cannula cleaned as necessary.

The rate and character of respirations are observed carefully—the development of Cheyne-Stokes or intermittent respirations may indicate rising intracranial pressure.

The position of the patient is of considerable importance. When the patient is being transferred from the operating table to his bed, the personnel must use gentle movements, and must never move the patient's head suddenly.

While the patient is asleep, it is safest to keep him in a supine position; however, the head and body must be turned to one side to obtain drainage of the tracheobronchial tree.

The patient must be turned at least every hour. Once the patient has recovered sufficiently to cough spontaneously and to prevent his tongue from fall-

When the continuity of a nerve is destroyed, function distal to the site of injury is lost. Recovery will occur only if regeneration of nerve axons takes place from the healthy proximal segments. These axons must grow down the axis cylinders of the nerve beyond the injury if they are to reinnervate their end organs and allow function to return.[10,12]

When a nerve is divided, the cut ends retract, become scarred, and form neuromas. Regenerating axons from the proximal segment cannot bridge such a gap or penetrate the scar tissue. An unobstructed path down the axis cylinder must be made available to them if they are ever again to move muscles or transmit sensation. All procedures are directed toward obtaining the most perfect conditions so that regeneration can occur.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup includes sharp scalpels, small tissue forceps, nerve hooks, small retractors, suction apparatus, the electrocautery, and a neurosurgical stimulator; also fine arterial silk or tantalum or stainless steel wire for the anastomosis, and padded plaster splints (Chapter 17).

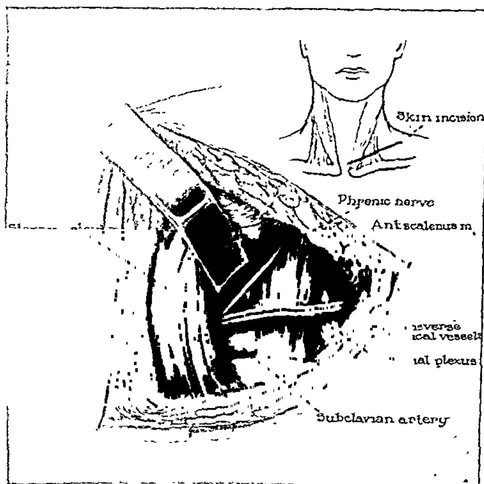


Fig 171.—The anatomy of anterior scalenus syndrome, showing the brachial plexus and subclavian artery which may become compressed between the anterior scalene muscle and the first rib, thereby producing vascular or neurologic signs and symptoms. Surgical treatment may be done if the mechanical and vascular tests produce evidences of compression and organic disease. (From Richards, V: Surgery for General Practice, St Louis, 1956, The C. V. Mosby Co)

hematoma formation. Morphine sulfate or similar analgesics are given to control postoperative pain.

Following the second stage of a two-stage thoracolumbar sympathectomy, the patient may suffer from a sharp drop in blood pressure. If the pulse rate remains stable and slow, this does not necessarily signify trouble. However, if the blood pressure rate drops below 80 or 90 systolic, corrective measures should be taken, such as elevating the foot of the bed, applying cotton elastic stockings to the legs, and administering a drug such as Neo-Synephrine intravenously.

Since the pleura may be entered in any thoracic sympathectomy, a portable chest film is taken in the recovery room to ascertain whether there is a pneumothorax. Since any residual pneumothorax is sucked out when the wound is closed, intrapleural drainage ordinarily is not used. If a large pneumothorax does show on the x-ray film, it may be aspirated in the recovery room, but this rarely happens.

Peripheral Nerve Surgery.—The patient requires adequate postoperative care as is necessary for other surgical patients. The involved extremity should be elevated and carefully protected. The nurse should observe frequently the circulatory status of the fingers or toes, as the case may be, and notify the surgeon of any abnormal swelling, temperature, or color. She should compare the injured toes or fingers with the normal ones.

REFERENCES

1. Ciba Foundation: The Ciba Collection of Medical Illustrations, vol. I, Nervous System, Boston, 1953, Little, Brown, & Co
2. Francis, C. C, and Farrell, G: Integrated Anatomy and Physiology, ed 3, St. Louis, 1957, The C. V. Mosby Co
3. Francis, C. C. Introduction to Human Anatomy, ed. 2, St. Louis, 1954, The C. V. Mosby Co.
4. Gutierrez-Mahoney, C. G de, and Carini, Esta: Neurological and Neurosurgical Nursing, St Louis, 1956, The C V. Mosby Co
5. Berman, J K.: Principles and Practice of Surgery, St. Louis, 1950, The C V. Mosby Co
6. Sachs, E: Diagnosis and Treatment of Brain Tumor and the Care of the Neurosurgical Patient, St. Louis, 1949, The C. V. Mosby Co.
7. Mettler, F. A Neuroanatomy, St. Louis, 1948, The C. V Mosby Co.
8. Walstenhelme, G. E W (ed) Ciba Foundation. Peripheral Circulation in Man, Boston, 1950, Little, Brown, & Co.
9. Ward, A. A: Central Nervous System; in Zimmerman, L. M., and others: Physiologic Principles of Surgery, Philadelphia, 1957, W. B Saunders Co, chap. 36
10. Zimmerman, L. M, Levine R., and others: Physiologic Principles of Surgery, Philadelphia, 1957, W B. Saunders Co.
11. Kahn, E. A, and others: Correlative Neurosurgery, Springfield, Ill, 1955, Charles C Thomas, Publisher.
12. Truex, R C, and Kellner, C E: Detailed Atlas of the Head and Neck, New York, 1948, Oxford University Press.
13. Moseley, H F. (ed): Textbook of Surgery, St. Louis, ed. 2, 1956, The C. V. Mosby Co
14. Ochsner, A., DeBakey, M. E., and others Christopher's Minor Surgery, ed. 7, Philadelphia, 1955, W B Saunders Co., chaps. 20 and 22.
15. Penfield, W: The Cerebral Cortex in Man, New York, 1950, The Macmillan Co
16. Bing, R. Local Diagnosis in Neurological Diseases, translated and revised from the 14th German edition by W. Haymaker, St Louis, 1956, The C. V. Mosby Co.

ing backward, the oral airway is removed. His head then is elevated moderately to promote better drainage of the intracranial veins.

The patient with a posterior fossa craniotomy is usually kept in a supine position for a few days, and when he is turned, he is rolled (as a log), without his assistance, to prevent tension on the suboccipital suture line.

The nurse is continually alert for vital signs and symptoms indicating postoperative hemorrhage. Normally, the patient should become progressively more alert, first responding to painful stimuli, and then to the spoken voice. The time at which spontaneous movements of the extremities first occur should be recorded. Observation of the pupils, their size, equality, and response to light, is important. Blood pressure, pulse, and respirations are recorded frequently. A rapidly rising blood pressure with the slowing of the pulse and changes in rate and character of respirations usually accompany an increase in intracranial pressure. A sterile lumbar puncture set should be available to perform an emergency ventricular tap in case of rapidly increasing intracranial pressure.

Convulsions demand energetic treatment to prevent tongue-biting and respiratory obstruction. Any significant regression in state of consciousness, sudden change in vital signs, the development of pupillary inequality, or progressive paresis of an extremity indicates trouble, and the surgeon should be notified. In such instances prompt operative reexploration of the wound may be necessary.

Temperature elevations are common following intracranial surgery, and a patient with a temperature of about 38.5° C. should be treated with cool body sponges and the administration of an antipyretic, such as aspirin.

Pain generally can be controlled adequately with small doses of codeine. Gentle restraints are useful for the restless patient; but a check for urinary bladder distention should also be made before applying them.

If a crinoline and starch head dressing has been applied, it must be dried quickly with a portable hair drier, taking care not to burn the patient's skin. A tracheotomy set must always be close at hand.

Laminectomy.—The immediate postoperative care of patients following operations involving the lumbar vertebras and the automatic nervous system depends somewhat on the nature of the lesion and the procedure performed. After most laminectomies, the patient is kept flat, but he is turned from side to side, keeping the spinal axis in a straight line. Acute movement of the neck is carefully avoided after cervical operations.

After cordotomy, with a marked drop in the blood pressure rate, the patient may be placed in a slight Trendelenburg position, a binder applied to the abdomen, elastic cotton bandages applied to the legs, and intravenous fluids administered. Because these patients can no longer perceive pain or temperature below the operative site, an air pressure mattress is the best insurance against pressure sores and decubitus ulcers. Hot-water bottles must never be used. The patient must be kept dry, and the sheets smooth and clean.

After any spinal cord operation it is important to note when the patient first begins to have spontaneous movements of his lower extremities, as the development of later paralysis may indicate postoperative compression due to a

CHAPTER 7

OPERATIONS ON THE NOSE, THROAT, NECK, AND FACIAL BONES

ANATOMY

The nose is divided into external and internal structures.[1-6] The external structure is composed of two nasal bones and the cartilaginous membrane. The external nose protects the nasal chambers and communicates through its openings (anterior and posterior nares) with the internal structures. The outside air enters the nasal cavities through the anterior nares, while the air from the nasal cavities passes through the posterior nares into the nasopharynx. The columella lies between the two nares and extends upward to the level of the cartilaginous septum on both sides of the nose. The alar cartilages, which are lined with skin, extend upward to the lateral cartilages (Fig. 172).[5, 7-10]

The internal nose is divided into a right and left chamber by a partition known as the nasal septum It extends from the front of the nose backward to the nasopharynx.[8] Anteriorly, the septum comprises the quadrilateral cartilages which articulate with the maxillae and vomer bones. It is formed posteriorly by the perpendicular plate of the ethmoid, partly by the nasal and sphenoid bones, the vomer, and portions of the maxillae and palatine bones.[4, 8, 9]

The nasal cavity is held together by the periosteal covering of the surrounding bones and by the perichondrium, which extends over the cartilages. Fine platysma muscles cover each side of the nose. Four of these muscles act as dilators and constrictors of the anterior nares, and another muscle covers the nasal bones and unites with the frontalis muscle above it. Abnormalities of the latter muscle may cause the so-called Grecian type of nose.[10] The nasal cavities are lined with mucous membrane consisting of a ciliated columnar epithelium, often known as respiratory epithelium. The stratified squamous epithelium, which lines the nares, contains numerous hairs that act as filters for the removal of dust from the inspired air.

The right and left nasal cavities of the internal nose are narrow and somewhat pyramidal in shape. The internal wall of the nasal cavities is formed by the nasal septum [4-6]

The three parallel curved bones, known as the inferior, middle, and superior turbinate bones, are attached to the lateral bones of the septum. The inferior turbinate bone is attached to the superior maxillary bone which forms the upper jaw. The middle turbinate and the superior turbinate are processes of the ethmoid bone. The turbinated bones of the nasal cavities are arranged one

17. Haymaker, W. E., and Woodhall, B. Peripheral Nerve Injuries: Principles of Diagnosis, Philadelphia, 1953, W. B Saunders Co
18. Walters, M. E.: Surgical Procedures in the X-Ray Department, Am. J. Nursing 57:623, May, 1957.
19 Richards, J.: Surgery for General Practice, St. Louis, 1956, The C V. Mosby Co.
20. Ingraham, F. D., and Matson, D. D: Neurosurgery of Infancy and Childhood, Springfield, Ill., 1954, Charles C Thomas, Publisher.
21. Fernel, J: in Major, R J Classic Description of Disease, ed. 3, Springfield, Ill, 1945, Charles C Thomas, Publisher.

above the other and are separated from each other by grooves which are known as meatuses. They act as the drainage passages of the accessory sinuses and are identified as the sphenoethmoidal recesses and the superior, middle, and inferior meatuses. (Fig. 173.)

The nasal accessory sinuses are air spaces which originate in the bones of the skull and communicate with each nasal cavity (Fig. 173). On each side of the skull there are, anteriorly, three openings, the frontal sinus, anterior ethmoid cells, and maxillary sinus (antrum of Highmore), which drain into the middle meatus; and, posteriorly, there are two openings, the ethmoid cells and the sphenoid sinus, which drain into the superior meatus and sphenoethmoidal recess.

The right and left frontal sinuses occupy space in the frontal bone just above the upper margin of the orbit and posterior to the eyebrow. Each frontal sinus drains through the nasofrontal duct into an opening beneath the middle turbinate. Endocranial and orbital complications may follow a severe frontal sinus disease because the very thin bone which separates the sinus from the brain and the orbit provides a poor barrier against infection.[3, 10-12]

The maxillary sinus (antrum of Highmore) may consist of one or more air spaces within the superior maxillary bone. The maxillary sinus is surrounded by the lateral nasal bones, the orbit above, the mouth below, and, posteriorly, by the nasal cavities, internal maxillary structures, and roots of the molars. The maxillary sinus communicates with the middle meatus. The infraorbital nerve passes across the roof of the sinus and the superior alveolar nerve travels along its floor.

The ethmoid cells are located in the body of the ethmoid bone. On each side the anterior ethmoid cells drain into the middle meatus situated below the middle turbinate, and the posterior ethmoid cells drain into the superior meatus situated above the middle turbinate.

The sphenoidal sinus occupies a space in the body of the sphenoid bone. This sinus opens into the superior meatus and is surrounded by several important organs. In the adult, the pituitary gland is situated above the sinus, the brain is situated behind it, the nasopharynx below, and the nasal cavity in front.[2, 3] The optic nerve lies in close apposition to this sinus (Chapter 6).

Nerve and Blood Supplies of the Nasal Cavity

The sensory nerve supply of the cavity is derived from the fifth nerve (trigeminal) (Chapter 6). Its branches enter the cavity at the anterior end of the ethmoid bone and extend to the external surface of the nose. Due to a limited sensory nerve supply in the external nose, block or regional anesthesia can be used effectively [1, 13] The olfactory nerve is located in the nasal mucous membrane (Chapter 6).

The nose receives its blood supply from branches of the internal maxillary artery.[3, 10] There are masses of communicating veins below the epithelial layer of the turbinated bones, and those vessels *lying just beneath the skin anastomose* freely. Dilation of the superficial veins may cause the turbinates to swell, or

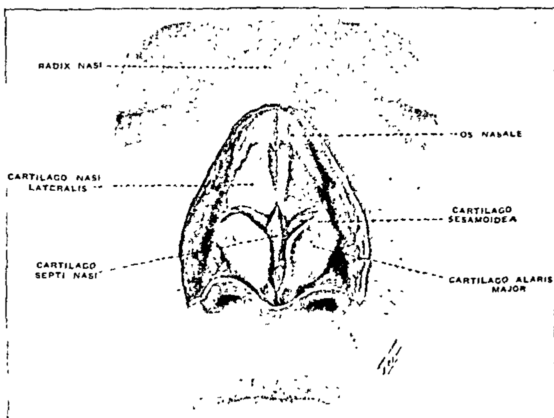


Fig 172.—The cartilages of the nose; anterior view (From Loeb, H. W.: Operative Surgery of the Nose, Throat, and Ear, St. Louis, 1924, The C. V. Mosby Co).

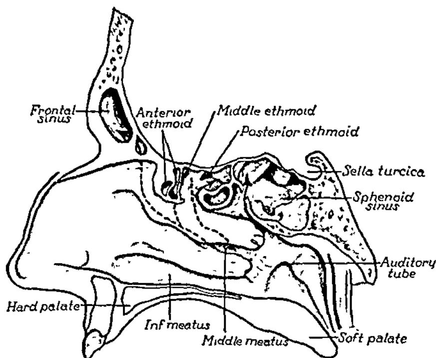


Fig. 173.—Openings of air sinuses Arrows indicate the openings from the nasal passages into the sinuses (From Francis, C C: Introduction to Human Anatomy, St. Louis, 1954, The C. V. Mosby Co)

the tip of the epiglottis. Situated at each side of the soft palate there are two folds of tissue which pass downward along each side of the tongue to form the anterior and posterior pillars of the fauces.

The tonsils consist of lymphoid tissue, which is enclosed in connective tissue known as the tonsillar capsule. The tonsils are situated on the lateral walls of the oral pharynx and lie between the folds of the fauces.[14, 17] The floor of each tonsil is formed by the constrictor muscles of the pharynx. The lingual tonsils are situated at the base of the tongue. The so-called tonsillar fossa is the cavity between the partially embedded anteroposterior pillars.

Normally, each tonsil contains crypts which extrude bacteria and waste products of the mouth.[18, 19] These crypts are ideal places for pathogenic bacteria to grow. When the crypts cease to drain, the bacteria form pus in the tonsils which must then be removed. The adenoids are also removed if they obstruct the air from passing through the posterior nares, thus interfering with nasal breathing. Because each vessel divides into several small vessels near the surface of the tonsillar capsule, during a tonsillectomy the dissection is made adjacent to the innermost layer of the capsule to avoid the larger vessels. The glossopharyngeal nerve (ninth cranial nerve) is closely associated with the tonsil, and the lingual branch of the trigeminal nerve lies near the lateral aspect of the tonsil.[8]

The larynx, which is a tubular structure about one and three-quarters inches long and one and one-quarter inches in diameter, contains the vocal cords.[3, 18-21, 23] The larynx is situated between the base of the tongue and the upper end of the trachea, and is lined with mucous membrane. The cavity of the larynx is divided into three compartments that are held together by folds of mucous membrane, ligaments, and muscles. The main cartilages of the larynx include three single cartilages known as the thyroid, cricoid, and epiglottis, and three paired cartilages called the arytenoid, corniculate, and cuneiform cartilages (Fig. 174).

The thyroid cartilage forms the anterior portion of the voice box. The cricoid cartilage, which resembles a signet ring, rests beneath the thyroid cartilage (Adam's apple) and within the laryngotracheal space.[9, 13, 15, 24] The arytenoid cartilages, which rest above the signet ring portion of the cricoid cartilage, support the posterior portion of the true vocal cords. The epiglottis consists of elastic cartilages.

The two chief groups of laryngeal muscles are known as the extrinsic and intrinsic muscles. The extrinsic muscles are attached to the larynx and move the larynx as a whole. These muscles are classified as muscles of the neck. The intrinsic muscles of the larynx, the aryepiglottic muscles and the transverse and oblique arytenoid muscles, act as a sphincter for the laryngeal outlet. They increase and decrease the tension folds which open and close the glottis to prevent food from entering the larynx.

The laryngeal cavity contains two folds of mucous membrane which stretch anteriorly and posteriorly. These are known as the false cords because they do not produce the voice. The two muscles (the true cords) which are situated below the false cords produce the voice. Anteriorly, the true cords are attached

contraction of these veins may cause them to shrink. The lymphatic system drains posteriorly through the superior deep cervical vessels.

The ear is composed of three parts: the external, the middle, and the internal portions. The external ear (auricle) contains cartilaginous tissue and the external auditory canal (meatus). The canal begins at the auricle of the ear and ends at the drum membrane of the middle ear, which is situated in the temporal bone. The squamous portion of the temporal bone acts as a shell for the ear. The mastoid portion, which is posterior to the external auditory canal, contains the mastoid air cells, and the petrous portion, situated at the base of the brain, contains the internal ear, the auditory nerve, and other structures[5, 6, 8]

The middle ear, which lies in the hollowed-out portion of the temporal bone, is lined with mucous membrane. This portion of the ear contains three auditory bones, the malleus, the incus, and the stapes. The mastoid antrum, which is situated on the posterior wall of the middle ear cavity, communicates with the mastoid cells, which are an overgrowth from the air cells in the mastoid bone.

The eustachian tube begins at the middle ear cavity and ends in the nasopharynx.[6, 8] It equalizes pressure on both sides of the eardum. By means of this tube an infection can spread from the nose or throat into the middle ear, and thence into the mastoid antrum and mastoid cells.

The internal ear comprises two sets of bony canals, three semicircular canals, the cochlea, and the vestibule. The internal ear contains the nerve of hearing and equilibrium. The external ear gathers the sound waves and transmits them through the external auditory canal to the middle ear, which gathers the sound impulses by means of ossicles. Within the internal ear the action of the ciliated epithelium transforms the sound vibrations into nerve impulses, which are transmitted through the auditory nerve to the brain, where they are interpreted as sounds.

Throat, Pharynx, Tonsils, Larynx, and Trachea

The throat is a musculomembranous canal about five inches long.[8, 14] It extends from the posterior nasal openings and the mouth above to the larynx, and the esophagus below (Fig. 174) The air passes from the nose and mouth through the pharynx to the larynx, and the food and water pass through the esophagus. Sounds of the voice are transmitted from the larynx.

The pharynx comprises three groups of muscles, the superior, middle, and inferior muscles, which act as constrictors upon the pharynx. Each muscle fits within the one below, and each helps to control and direct the passage of food from the interior of the pharynx into the esophagus by drawing the larynx upward and forward (Fig. 174).

The air passes from the nose to the larynx through a passageway known as the nasopharynx, which lies above the soft palate. Lying within the nasopharynx there are the posterior nares, posterior border of the nasal septum, ends of the eustachian tubes, adenoids, and two openings for the eustachian tubes. The oropharynx begins at the level of the soft palate and extends to a point near

that become numerous capillary air alveoli in the lung. The divisions of the bronchi and lungs are described briefly in Chapter 9.

OPERATIONS

Corrective Rhinoplasty

Definition.—Removing the hump, narrowing and shortening the nose, or reconstructing the tip of the nose.

Purpose.—Brown[10] states, "Contour of the anatomy of the nose is a term suggested to designate a definite function of the nose, which is that of being normal in appearance."

Considerations.—Interference of normal facial appearance may result from trauma, new growths, or ancestral characteristics. Rhinoplasty may help in solving the patient's physiologic, psychologic, or economic problems.[7, 10, 18] A sensitive person may think that the world is a happier place in which to live; however, surgery can do little for the patient who is chronically unhappy or psychotic. The patient who suffers from personal distress and embarrassment due to physical deformities of the nose, such as interference with smiling or lip movements, to obstruction of the nasal airways, or to a wide bony nose, flared nostrils, or a hooked or long distorted nose may find his career hampered, thus decreasing opportunities for economic security.[25-28]

Contraindications.—A rhinoplasty procedure is not performed in the presence of a respiratory infection.[10, 17]

Precautionary Measures.—To prevent or control infection and the formation of a hematoma the measures include the following: removing the bone dust and loose bone chips, applying sterile wound dressings, sterile splint, or adhesive tape correctly, changing the dressings frequently, and administering antibiotics.[10,17,27] Specific instruments are needed (Figs. 175 and 176).

Procaine solution is not used if it has become yellow, since it is usually weakened by storing for a long period or by repeated autoclaving. Pentothal sodium and oxygen therapy should be available to treat the patient who has had an Adrenalin or procaine reaction.

Setup.—The instruments shown in Figs. 175 and 176, plus the following:

Unsterile Items

1 Portable adjustable instrument stand
1 Small preparation stand or table
1 Instrument table
2 Suction machines
1 Head light and cord
2 Footstools

Sterile Items

Skin preparation setup
Minor operating linen pack
Minor basin set
Gown pack
Gloves
Local set and anesthetic
Adrenalin solution 1:1,000
Absorbent cotton
Cotton applicators
Gauze sponges, desired sizes
Cotton tape, narrow
Nasal packing, desired type and size

to the posterior surface of the thyroid cartilage, and, posteriorly, they are attached to the arytenoid cartilages. The true cords are brought together by the intrinsic muscles, which are tightened as the supporting arytenoid cartilages take their normal position. Since the membrane of the larynx is closely adherent to the epiglottis and to the vocal folds, when the epithelium becomes severely swollen, the air cannot pass through the larynx.[18, 20] In such conditions the surgeon may insert a tube through the larynx or make an opening into the trachea.[12, 13, 23, 24]

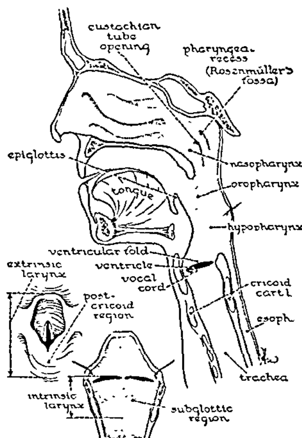


Fig. 174—Anatomy of the pharynx and larynx (From Moseley, H. F.: Textbook of Surgery, St Louis, 1955, The C V. Mosby Co.).

The recurrent laryngeal nerve (a motor nerve) supplies the intrinsic muscle. The superior laryngeal nerve, which is a branch of the vagus nerve, is the main sensory nerve When the recurrent laryngeal nerve is cut or paralyzed, the patient loses his voice. In the presence of a lesion of the larynx or epiglottis the superior laryngeal nerve may be infiltrated with alcohol or cocaine solution to relieve the patient of severe pain when he swallows. The larynx derives its blood supply from branches of the external carotid and subclavian arteries.

The trachea (a cylindrical-shaped tube) is composed of cartilage that extends from the larynx above to a point opposite the fifth dorsal vertebras below. The upper portion of the trachea is about four and one-half inches in diameter, and it divides into right and left portions which are called bronchi. (Chapter 9.) They in turn divide into smaller tubes, terminating in fine bronchial tubes

Fig 175.—Nasal setup used by Maurice H. Cottle, M.D. (From the V. Mueller Armamentarium, No. 10, with permission of V. Mueller & Co., Chicago.)

1, Bard-Parker knife handle No. 3
Bard-Parker rib-back blades No 11
2, Bard-Parker knife handle No. 3
Bard-Parker rib-back blades No 15
3, Cottle knife, double-edged, straight
4, Fomon knife, double-edged, curved
5, Joseph buttonhole knife, straight
6, Cottle knife, straight
7, Cottle skin elevator, curved
8, Pierce submucous dissector
9, Cottle elevator, graduated
10, MacKenty septum elevator
11, *Cottle bulldog scissors, 4½ inches*
12, Knapp stabismus scissors, curved
13, Knapp iris scissors, curved, sharp pointed
14, Foman upper lateral scissors, full curved
15, Cottle angular scissors, 6½ inches
16, Fomon angular scissors, light
17, Straight scissors, spring action
18, Kelly artery forceps, straight
19, Aufricht nasal speculum, fenestrated
20, Aufricht nasal speculum, solid
21, Cottle alae protector
22, Cottle 4-prong retractor, blunt
23, Cottle-Neivert retractor, double-ended
24, Cottle 2-prong retractor, small
25, Cottle 2-prong retractor, large, sharp
26, Straight's single tenaculum
27, Cottle single tenaculum
28, Cottle columella clamp
29, Cottle lower lateral forceps, bayonet
30, Gruenwald nasal dressing forceps, 6¼ inches
31, Cottle-Graefe tissue forceps
32, Cottle-Killian nasal speculum
33, Vienna nasal speculum, medium
34, Oil stone, for honing knives
Stainless tumbler, for peroxide
Stainless tumbler, for water

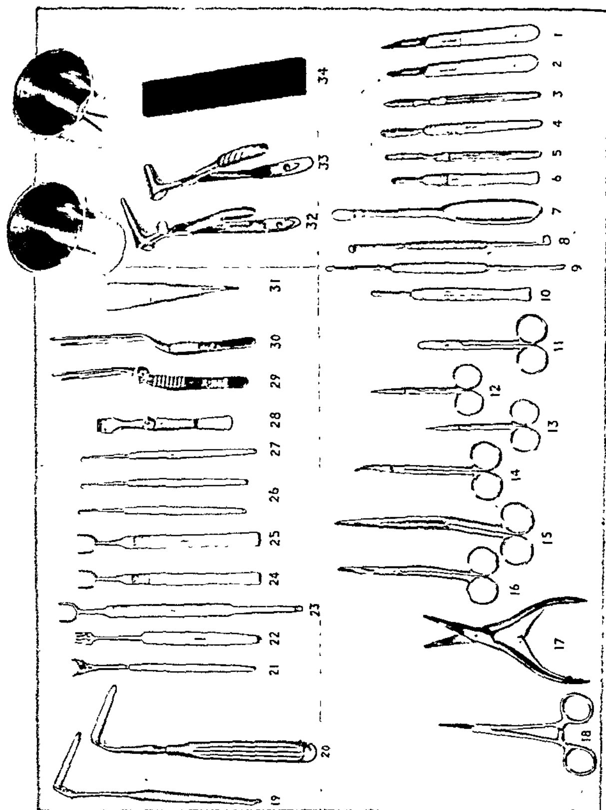
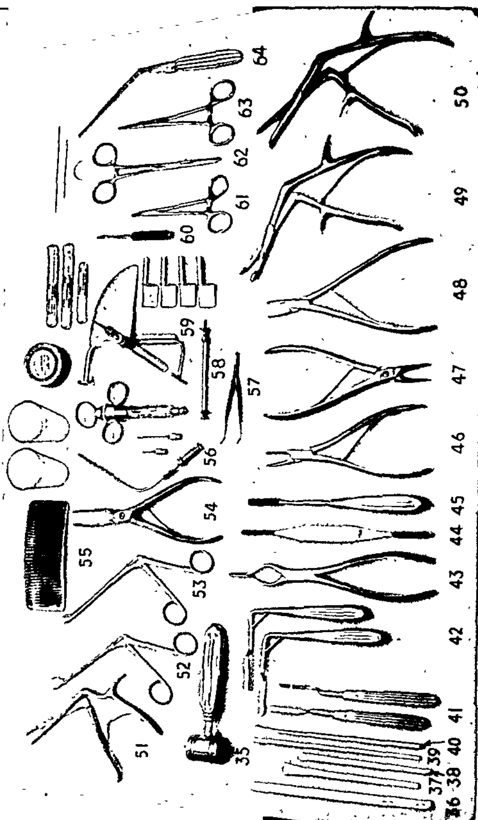

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Fig 176.—Nasal setup used by Maurice H. Cottle, M D.—cont'd. (From the V. Mueller Armamentarium, No. 10, with permission of V. Mueller & Co., Chicago)

35, Crane mallet, small, bronze head
36, Cottle bone lever, blunt end
37, Cottle chisel, 12 mm., thin blade, rounded corners
38, Cottle chisel, 8 mm., thin blade, rounded corners
39, Cottle chisel, 4 mm., thin blade, rounded corners
40, Cottle chisel, curved, one side
41, Joseph bayonet saw, right
Joseph bayonet saw, left
42, Joseph-Maltz angular saw, right
Joseph-Maltz angular saw, left
43, Cottle-Walsham septum straightener
44, Foman rasp, double ended
45, Cottle nasal rasp (Sweeper)
46, Cottle-Kazanjian cutting forceps
47, Kazanjian nasal hump-cutting forceps
48, Cottle-Lempert rongeur forceps
49, Cottle septal ridge-cutting forceps, right
50, Cottle septal ridge-cutting forceps, left
51, Koffler-Lillie septum bone forceps
52, Ferris Smith fragment forceps
53, Bruening septum forceps, alligator jaws, 6.5 mm. wide
54, Cottle-Jansen rongeur forceps, angular jaws, with cupped portion of jaws straight
55, Turchik instrument holder
56, Frazier nasal suction tube
57, Prince forceps, with teeth
58, Cottle cartilage holder
59, Cottle profilometer
60, Keyes punch, 2 mm. diameter
61, Neivert needle holder
62, Allis tissue-holding forceps, 6 inches
63, Kelly artery forceps, straight
64, Joseph measuring instrument, angular
Dermalon suture No. 5 0
Plain catgut suture No. 3 0
Plain catgut suture No. 2 0
Deknatel braided black silk No. 2 0
Keith needles, 4 inches
Keith needles, 2½ inches
Cutting needles, curved, size 20
Luer-Lok control syringe, 5 ml.
Hypodermic needles, 22 gauge, 2 inches
Hypodermic needles, 25 gauge, ½ inch
Medicine glass, for cod-liver oil
Medicine glass, for methylene blue


LARGE TABLE
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Steps	*Items*
the lower end of septum may be removed.	
5. The bony fragments and bone dust are removed.	5. Suction set, sponges, alligator and nasal forceps
6 The edges of the cartilages are trimmed.	6. Scissors, retractors, forceps (Fig. 176)
7. The blood is pressed out of nose, and the cartilages and bones are molded into proper position. The columella is sutured back to the septum. The membraneous septum is closed with fine sutures. The columella mucosa is united to the septal mucosa.	7. Compresses, silk Nos. 4-0 and 5-0 swaged-on needles, needle holders, scissors, tissue forceps, Halsted hemostats

8. A dressing and a splint are applied. The splint of metal is molded to the entire nose and held in place with sterile ½-inch adhesive strips or a single or double row of cross-strips of adhesive tape, first from the tip of the nose to the glabella and then single vertical strips on either side. Packing may or may not be used. A small gauze pad may be taped over the tip of the nose to absorb any bleeding. The head is elevated, and ice packs may be applied to the eyelids.[7, 10, 25]

Submucous Resection of the Septum

Definition.—Removal of the bent portions of the septum that lie between the flaps of mucous membrane.

Purpose.—To establish a straight partition between the left and right nasal cavities, providing a clear airway through both sides of the nose.

Indications.—When the nasal septum is bent, due to either a faulty development of the septum or an injury to the nose, the patient's symptoms include poor or difficult nasal breathing or obstruction of nasal drainage.[6, 27, 28]

The deviations of the septum may involve the cartilage or bony portions of the nose or both The bony deviations, which are called spurs, form in the lower part of the nose, thus blocking the meatus. The cartilaginous deviations involve the upper portions of the quadrilateral cartilage. An extensive septal deviation to one side may compress the middle turbinate on the same side and may obstruct the sinus opening Septal deviations tend to cause sinus disease and form polyps[5, 8, 17]

Precautionary Measures.—The room should be darkened. The reflecting lamp, operating table, suction set, and other pieces of equipment must be ready and in working order. If the operation is to be performed using topical anesthetics, the medication glasses that are used to store the solutions of cocaine and Adrenalin should bear a marking to designate the solution. A Pentothal sodium setup and oxygen therapy equipment also must be ready for immediate use. Adrenalin is used to prolong the effects of the cocaine solution and to control bleeding.

Position, Skin Preparation, and Draping Procedure.—It is important that the team use a sympathetic and understanding approach toward the patient as they care for him. The patient is placed on the operating table in a supine position (Chapter 4). A small sandbag or sponge-rubber pad may be placed against each side of the head. A small, thin sponge-rubber pad should be placed under his shoulders and his head supported by a pillow to make it easier for him to breathe.

The skin preparation and draping of the patient with sterile sheets include the following: (1) Clip the vibrissae from the interior nose, using fine plastic scissors. (2) Cleanse the inside of the nose with applicators dipped in a solution, and then cleanse the face and upper neck regions, using a suitable cleansing agent. (3) Place a small sheet with two sterile towels on top of it over the head of the table under the patient's head, grasp the uppermost towel and wrap it around his head, covering the hairline, and fasten the towel in place with a towel forceps. (4) Cover the patient with a large sterile sheet. (5) Connect the suction set and place the sterile table near the patient's head.

Operative Procedure.—The major steps of a rhinoplasty and the items used are as follows:

Steps	*Items*
1. After the patient is draped with sterile sheets, the anesthetic is injected into the nasal membrane. An incision is made through the skin, detaching the cartilaginous septum and nasal spine from the columella. A second incision is made in the other nostril and is carried around the columella, where it joins the first incision, or a rim incision is made when reconstructing the lateral cartilages. A semicircular incision is made just inside the nostril rim for exposure of the alar cartilages.	1. Nasal speculum, sponges, scalpel, with blade No. 15, suction set, Adrenalin cotton swabs, skin hooks, iris scissors, S-ribbon retractor hook
2. The skin of the nose is undermined by starting at the tip, proceeding upward, then downward over the frontal processes of the maxillae on each side	2. Scalpel, straight, sharp-pointed scissors, long curved scissors, and blunt scissors, Joseph elevator gauze sponges, retractor (hook type), double-edged knife (Fig. 175)
3. The periosteum and perichondrium are incised and freed from their underlying structures. The tissues are scraped downward and the nostril is elevated.	3 Joseph type elevator periosteotome, Joseph right or left saw, septal elevator (Fig. 175)
4. The nasal bone or the upper lateral cartilage is fractured; the hump is removed; a strip of cartilage may be removed; also a rectangular or wedge-shaped piece of	4. Joseph bayonet saws, Crile or Kelly hemostats, sponges, suction set, rasp, S-ribbon retractor, long scissors, curved osteotomes, chisels, bayonet forceps, heavy scissors

Steps	*Items*
the lower end of septum may be removed.	
5. The bony fragments and bone dust are removed.	5. Suction set, sponges, alligator and nasal forceps
6. The edges of the cartilages are trimmed.	6. Scissors, retractors, forceps (Fig. 176)
7. The blood is pressed out of nose, and the cartilages and bones are molded into proper position. The columella is sutured back to the septum. The membraneous septum is closed with fine sutures. The columella mucosa is united to the septal mucosa.	7. Compresses, silk Nos. 4-0 and 5-0 swaged-on needles, needle holders, scissors, tissue forceps, Halsted hemostats

8. A dressing and a splint are applied. The splint of metal is molded to the entire nose and held in place with sterile ½-inch adhesive strips or a single or double row of cross-strips of adhesive tape, first from the tip of the nose to the glabella and then single vertical strips on either side. Packing may or may not be used. A small gauze pad may be taped over the tip of the nose to absorb any bleeding. The head is elevated, and ice packs may be applied to the eyelids.[7, 10, 25]

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The circulating nurse should observe the patient closely and should report any vital reactionary signs to the surgeon promptly so that oxygen can be administered immediately.

If an irritating solution is to be used on an applicator or instrument, the nurse should remove the excess solution from it before she hands it to the surgeon. If the excess solution goes into the patient's throat it causes him to cough and creates a spasm of the larynx. Several antrum cannulas and pliable stilettes should be available. The use of selvaged gauze packing prevents frayed threads from entering the nose.

To provide for adequate illumination into the nose when the patient is placed in a sitting position, the floor lamp should be placed about one foot behind the head of the operating table on the right side. When the patient *is placed on the operating table in a supine position, the lamp is placed near* the head of the table. The surgeon adjusts his head mirror, using a sterile clothespin that has been clipped to the mirror.

After completion of the operation, the patient must not be moved abruptly from the operating table onto the bed or stretcher. The nurse should check and record his pulse, respiration and blood pressure.

Setup includes the following:

Sterile Items

3 Killian or Vienna nasal specula, desired size
3 brown copper applicators
1 Jansen single-end or Gruenwald nasal dressing forceps, bayonet shape
1 Wilde nasal dressing forceps, angular, with serrated jaws
1 Scalpel handle No. 3 with blade No. 15
2 Freer or Killian septum elevators
1 Pierce submucous dissector double-ended, right or left
1 Freer septum knife, rounded blade, or Joseph nasal knife double-edged straight blade
2 Ballenger swivel knives, desired sizes
2 Hartmann septum forceps, alligator action
1 Jansen-Middleton septum punch forceps, angular on flat, if desired
1 Luc nasal cutting forceps, curved sideways
2 Freer septum chisels, desired sizes
1 Ballenger nasal gouge
1 Wilde-Newmann antrum gouge, if desired
2 Killian or Kelly gouges, angled
1 Mallet
1 Van Struycken septum cutting forceps, if desired
1 Lillie-Killian septum bone-cutting forceps
2 Eicken antrum cannulas, 5½ inches, open bulbous end
1 Ingals antrum cannula
1 Suture scissors
1 Knight nasal scissors
2 Pieces of suction tubing
2 Towel forceps
1 Needle holder
2 Septum needles, ½-circle swaged-on silk No 4-0 or 3-0
1 Crile hemostat, straight
1 Mayo-Pean hemostat, curved jaw

Other Sterile Items

1 Minor linen pack
1 Minor basin set
1 Gown and glove set
6 Towels
1 Regular draping sheet
Absorbent cotton
Sponges, 3 by 3 inches
Submucous sponges
Petrolatum gauze packing ½ inch wide

Topical Anesthetic Setup

Drugs may include 10 or 20 per cent cocaine solution, or cocaine flakes *moistened in sterile distilled water;* or 2 per cent procaine solution

Absorbent cotton
Cotton applicators
Brown copper applicators
Nasal speculum
Nasal dressing forceps
Medication cups and identification labels
Compresses
Small basin
Straight scissors
Adrenalin solution 1:1000
2 ml. Luer-Lok syringe
Novocain solution 1 or 0.5 per cent
Clothespin

Unsterile Items

Instrument table
Portable stand
Reflecting lamp
Head mirror
Suction apparatus
2 Pillows and footpiece for operating table

Position, Skin Preparation, and Draping Procedure.—The patient is generally placed on the operating table in a sitting position. Before the patient arrives, the nurse adjusts the operating table as follows: Attach the footpiece at a right angle and place a pad or folded sheet on the table, allowing it to rest against the footpiece (Chapter 4). Make the table into a reclining chair and place a folded sheet or small pillow over the break of lower sections. Greet the patient by name and assist him onto the table. Support the lumbar curvature and knees, using small pillows or pads. Place a pillow under his head and shoulders. Adjust the sections of the table to suit the patient, and raise or lower the table to suit the surgeon.

The patient's face is cleansed with a mild soap, water, and a weak solution of alcohol. His eyes should be protected with damp gauze compresses.

A large sterile sheet is draped over the patient in such a way that it encircles the neck and shoulders His head may be covered with a small fenestrated sheet through which the nose is exposed; or sterile towels may be placed around his head and fastened in place with towel forceps, leaving his face exposed but his eyes covered.

Operative Procedure.—The setup must meet the surgeon's preferences in treating each patient's condition. The items usually needed to perform a submucous resection are listed opposite each operative step as follows (Fig. 177):

Steps	*Items*
1. A curved or S-shaped incision is made through the mucous membrane and perichondrium of the nasal septum.	1. Nasal speculum, scalpel, Novocain solution may be injected
2. The mucous membrane and perichondrium are separated and elevated.	2. Septal elevators, sharp and blunt; bayonet forceps, submucous sponges, Freer round-bladed knife, suction set
3 The cartilage is incised and the mucous membrane on the opposite side from the original incision is elevated. Deviated cartilage and thickened bony structures are removed.	3 Scalpel, elevators, Ballenger swivel knife, septum nasal punch, bayonet nasal forceps
4. The mucous membrane is freed on both sides from the bony base of the septum.	4. Septum elevators, chisels, mallet, gauze sponges, septal forceps and punch forceps, suction set, probe

Steps	*Items*
5. The perpendicular plate of the ethmoid may be removed and followed by removal of the vomer, if necessary.	5. Septum forceps, chisel, mallet, and scalpel
6. The incision may or may not be sutured.	6. Septum sutures, needle holder, scissors
7. Each nostril is packed with gauze packing so as to hold septal flaps in midline position.	7. Petrolatum gauze packing; bayonet nasal forceps, Killian speculum
8. The face is cleansed and dried.	8. Damp and dry gauze compresses.

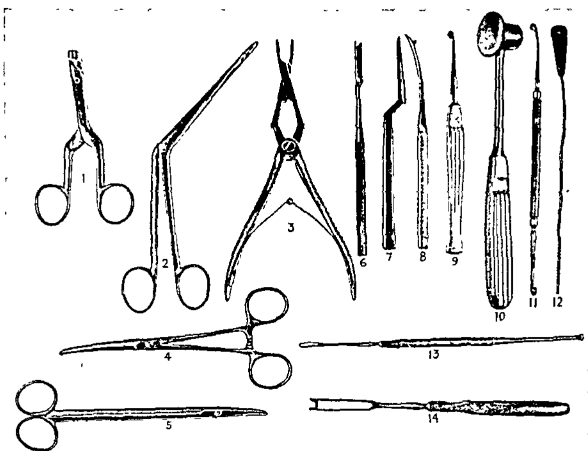


Fig 177—Submucous resection instruments: *1,* Lutz septal ridge nasal-cutting forceps; *2,* Lillie-Killian septum bone forceps; *3,* Jansen-Struycken septum forceps; *4,* Mayo-Pean hemostat; *5,* Metzenbaum scissors, *6,* Hajek septum chisel, V-shaped; *7,* Newmann gouge, *8,* Faulkner antrum chisel, *9,* Freer septum chisel; *10,* mallet; *11,* Pierce submucous dissector; *12,* silver probe; *13,* Killian periosteal elevator; *14,* Ballenger swivel knife.

Intranasal Antrostomy
(Antral Window)

Definition.—An opening made under the middle turbinate and the lateral wall of the nose in order to remove the anterior end of the inferior turbinate.[17, 19]

Purpose.—To establish drainage of the maxillary sinus.

Precautionary Measures.—As for submucous resection.

Sterile Setup.—

2 Hartmann and Coakley specula
1 Aufricht nasal speculum or retractor
3 Brown copper applicators, rough end
1 Jansen or Gruenwald nasal dressing forceps, bayonet-shape
1 Wilde nasal dressing forceps
3 Eicken antrum cannulas
1 Scott nasal suction tube
3 Pieces suction tubing
1 Suture scissors
1 Knight nasal scissors
1 Knight or Myles nasal cutting forceps, alligator action
2 Van Struycken nasal cutting forceps
2 Bruening septal cutting forceps
4 Antrum punch forceps including cutting forward, backward, upward, and downward
2 Universal handles for antrum punch forceps
2 Wilde ethmoid exenteration forceps, desired type and size
1 Mayo-Pean hemostat, curved jaw
1 Scalpel handle No. 3 with blade No. 15
2 Freer septum elevators
2 Freer bone chisels, desired sizes
1 Hajek septal chisel, V-shaped
1 Kelly antrum gouge
2 Coakley antrum trocars
1 Pierce-Myerson antrum trocar, if desired
1 Thornwald antrum perforator and irrigator
1 Wiener-Pierce or Robb antrum rasp
2 Douglas or Krause nasal snares with wire loops No. 4 or 5
4 Coakley curettes, angled, various sizes
1 Stainless steel wire for cleaning antrum cannulas
2 Specimen jars
1 needle holder
Topical anesthetic setup, if desired
Mouth gag
Throat suction set
Ether hook
Postnasal plug setup
} If general anthesetic is administered
Nasal petrolatum gauze packing $\frac{1}{4}$ or $\frac{1}{2}$ inch wide

Sterile Sutures and Textiles

As for submucous resection

Position, Skin Preparation, and Draping Procedure.—As for submucous resection.

Operative Procedure.—The items needed to perform an intranasal antrostomy are shown in Fig. 177 and listed opposite the operative steps as follows:

Steps	*Items*
1. A postnasal plug is inserted	1. Dental roll, silk, hemostat, catheter, nasal forceps
2. Exploration of the inferior turbinate is identified. Anterior end of inferior turbinate may be opened and resected from the external wall of the nasal fossa.	2 Speculum, nasal snare, septum bone-cutting forceps, suction set, submucous sponges
3. An opening is made into the maxillary sinus beneath the inferior turbinate.	3. Kelly or Anderson gouge, Thornwald antral perforator, Hartmann nasal forceps, dressing nasal forceps, suction set, antrum cannulas, probe
4. The opening is enlarged. Accessible polyps and degenerate mucosa are removed from sinus.	4. Rasp, nasal cutting forceps, antrum punches and universal handle

Steps	*Items*
5. The sinus may be irrigated and packed.	5. Thornwald irrigator, saline solution, suction set, sponges, dressing forceps, petrolatum gauze packing, ¼ or ½ inch wide
6. The face is cleansed and dried.	6. Moist and dry gauze compresses

Removal of Nasal Polyps

Definition.—Removal of nasal polyps.

Setup and Operative Procedure.—Nasal polyps arising from the border of the middle turbinate may be simply removed by means of a submucous setup, using a nasal snare.

Polyps, which arise from above or from the hiatus semilunaris, may involve one of the sinus cavities, thus necessitating surgery of the sinus. In such cases a setup for an intranasal antrostomy, Caldwell-Luc, ethmoidectomy, opening of the sphenoids, or enlargement of the frontal sinus duct may be required.[6, 8]

Radical Antrostomy (Caldwell-Luc)

Definition.—Through an incision into the canine fossa of the upper jaw, exposure of the antrum, removal of the bony diseased portions of the antral wall and contents of the sinus, or establishment of drainage by means of a counter-opening into the nose through the inferior meatus.

Purpose.—To establish adequate drainage and aeration, and to remove all infected tissue and fluid in the cavity.[18,29]

Indications.—Surgery is indicated when the acute sinus disease has caused the mucous lining of the sinus to become thickened. The irritation of pus on its interior may produce polyps, which obstruct the nasal cavity and may extend into the nose.[6,27] The blood stream may absorb the toxic material, which in turn will cause inflammation in other parts of the body.

The symptoms of chronic sinusitis are nasal catarrh, headaches, and a chronic cough. Asthma may be associated with a chronic sinusitis, especially if an allergy exists, and symptoms of arthritis and iritis may result.[28]

Precautionary Measures.—As for submucous resection.

Setup.—Intranasal antrostomy set, adding the following:

Davis or Jenning mouth gag and tongue blade if general anesthetic is administered
Throat suction tube
Postnasal packing setup — hemostat catheter No. 14 F, tampon and silk cord attached (Fig. 178)
1 Love nasopharyngeal retractor, if desired
Roller gauze, 1 inch wide
1 Aufricht or Converse nasal retractor
1 Davis, Volkman, or Miller retractor
1 Shearer lip retractor
1 Seiler turbinate scissors, angled on side
1 Tissue forceps with one and two teeth
1 Tissue forceps without teeth
2 Myles antrum curettes
4 Coakley curettes
2 Silver probes
3 Hajek sphenoid punch forceps, desired types
1 Hurd or Lutz septum bone-cutting forceps

1 Kerrison cutting forceps, if desired
4 Mosquito hemostats, straight
4 Kelly hemostats, curved
2 Specimen jars
Sutures — swaged-on plastic needles ½-circle, cutting-edge, silk and chromic gut No. 2-0
Long fluff gauze sponges
Gauze compresses, 4 by 4 inches
Penrose drain, ⅜ inch wide
Antibiotic solution, desired type, in nasal spray

Position, Skin Preparation, and Draping Procedure.—As for submucous resection, except the patient is generally placed on the operating table in a supine position, with the shoulders supported by a pillow or small pad and the head stabilized on a headrest or ring (Chapter 4).

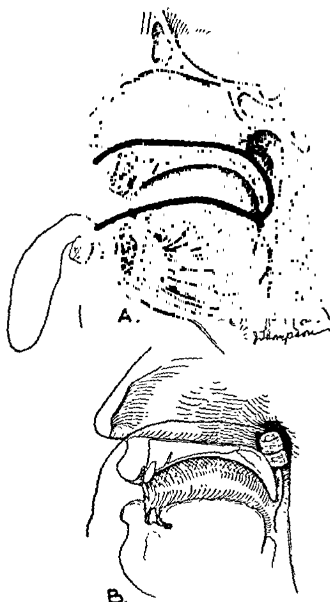


Fig. 178—Posterior nasal pack. (From Richards, V: Surgery for General Practice, St. Louis, 1956, The C V. Mosby Co)

Operative Procedure.—The items used in performing a radical antrostomy are listed opposite the operative steps as follows:

Steps	*Items*
1. After the patient has been anesthetized, a postnasal plug is inserted into the nasopharynx cavity. Gauze packing is placed in the buccal cavity against the cheek.	1. Mouth gag, tongue blade, ether hook, postnasal packing setup, nasal dressing forceps, Davis or Miller retractors, suction set, throat suction tube, petrolatum, scissors, sterile draping sheets
2. The labial commissure is retracted.	2. Right-angled retractors
3 The incision is made down to bone over the canine fossa.	3. Scalpels, blade No. 10 or 15
4. The bleeding vessels are manually controlled, or clamped and ligated.	4. Kelly or mosquito hemostats, surgical gut plain No. 2-0 or chromic No. 3-0, scissors, gauze compresses, suction set

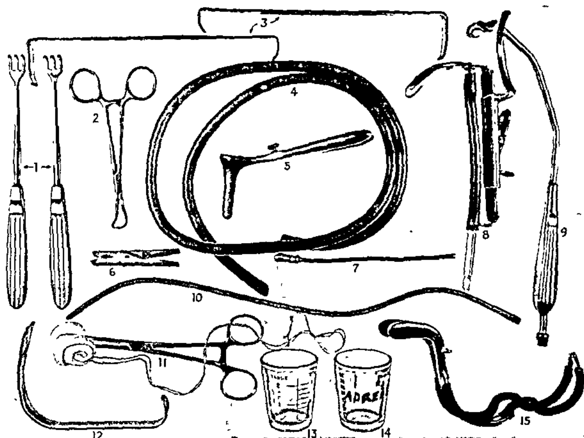


Fig 179—Instruments for radical antrum and sinus operations. *1*, Volkman rake retractors, dull points, *2*, Backhaus towel forceps, *3*, Freer right-angled antrum retractors, *4*, suction tubing; *5*, Killian nasal speculum, *6*, clothespin, *7*, Ingales antrum cannula; *8*, Davis mouth gag with tooth plate, tongue blade, and ether hook, *9*, Yankauer throat suction tube, *10*, catheter No 12 F; *11*, postnasal plug and forceps, *12*, Weder tongue blade, *13-14*, medication cups; *15*, Jennings mouth gag with rubber guards

Steps	*Items*
5. The wound edges are retracted.	5. Right-angled retractors
6. The periosteum is separated and elevated, exposing the anterior surface of the maxilla.	6. Elevators, suction set
7. An opening is made into the cavity of the sinus.	7. Chisel, mallet, antrum suction set, nasal dressing forceps, sponges
8. The opening is enlarged.	8. Myles or Hartmann cutting forceps and Wilde nasal forceps
9. The cavity is explored. All pus and polypoid membrane are removed.	9. Coakley curettes, Hurd or Lutz forceps, fluff gauze sponges, flexible probe
10. The entire lining of the sinus cavity is removed.	10. Nasal cutting forceps, Faulkner curette, bayonet forceps

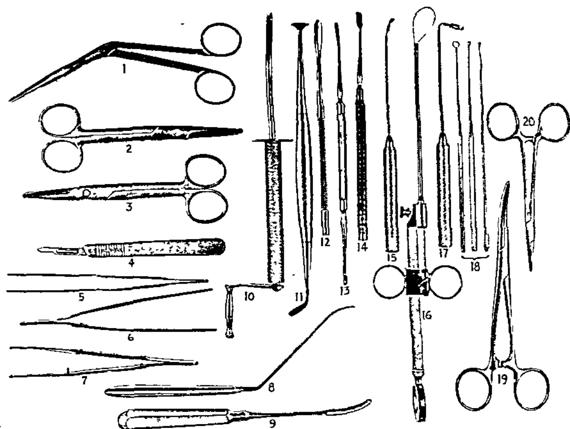


Fig 180—Instruments for radical antrum and sinus operations—cont'd *1,* Knight nasal scissors; *2,* Mayo dissecting scissors; *3,* Mayo dressing scissors, *4,* scalpel handle No 3 and blade No 11, *5,* Wilde dressing forceps; *6,* tissue forceps without teeth; *7,* tissue forceps with 1 and 2 teeth, *8,* Brawley sinus rasp; *9,* Brawley antrum rasp, *10,* Thornwald sphenoid perforator and irrigator, [illegible] id dissector, blunt-ended; 12, Foman periosteotome; [illegible] septum chisel, 3/16 inch wide; *15,* Ballenger ethmoid [illegible] kley ethmoid curettes, *18,* Myles antrum curettes; *19,* [illegible] mostat.

Steps	*Items*
11. A large nasoantral opening is made to establish communication between the maxillary sinus and the nasal fossa.	11. Antral cutting forceps (Jansen-Middleton), Mayo-Pean hemostat, rasp, antrum angled cannula, suction set
12. All debris of the bone and mucous membrane is removed.	12. Cutting forceps, Cullom septum punch or Jansen-Struycken septal forceps; antiseptized gauze sponges may be used
13. The retractors are removed. Packing is introduced into the antrum and brought into the nasal fossa.	13. Petrolatum gauze packing, bayonet forceps
14. *The labial incision may or may* not be sutured.	14. *Curved septal cutting-edge nee*dles, needle holder, chromic gut sutures No. 2-0 or silk No. 2-0 or 3-0, scissors, tissue forceps, and sponges
15. Fluff gauze is introduced into the nose.	15. Fluff gauze dressing, bayonet forceps
16. The face is cleansed and dried.	16. Gauze compresses

Insertion of Postnasal Packing

Definition.—Placement of a tampon into the throat through the nose by means of a catheter.[24]

Sterile Items.—One catheter size No. 8 F, rolled gauze compress or dental roll, one strand of heavy silk 18 inches long, Mayo-Pean curved hemostat, a tongue depressor, straight scissors, two adhesive strips (each 2½ inches long). The gauze roll is tied in the center with three pieces of heavy silk in such a way that three free ends are about 8 inches long (Fig. 178).

Operative Procedure.—

1. The catheter is passed through the nose into the throat.

2 The end of the catheter is grasped with a hemostat and then pulled through the mouth.

3. The two strings which encircle the tampon or roll are tied around the end of the catheter, which is projecting from the mouth.

4. The catheter is pulled back through the nose, taking with it the strings and tampon; then the catheter is discarded, allowing the strings of the tampon to pass through the nose to the back of the pharynx and to the free edge of the palate. The tampon is push tightly into the nasopharynx.

5. The ends of one string are secured to the anterior nares, and the ends of the second string (lying in the mouth) are cut near the roll so that they can be seen readily.

6. *The roll is removed by freeing the string from the nares and pulling* on the free ends of the strings in the mouth.[8, 13, 24]

Frontal Sinus Operation
(External Approach)

Definition.—An incision is made above the eyebrow of the affected side through the anterior wall and floor of the frontal sinus; then the diseased material and tissue are removed, the sinus is cleansed, and drainage is established.[5, 6, 15]

Purpose.—To treat chronic infection of the frontal sinus and to establish drainage from the sinus into the nose.

Sterile Setup.—Radical antrostomy setup, adding the following:

2 Davis retractors
1 Weitlaner self-retaining retractor
1 Potts tenaculum, blunt hook
2 Allis forceps
4 Kelly hemostats, curved jaws
1 Graduated sinus probe
2 Brawley or Weiner frontal sinus rasps
2 Ferris, Smith-Kerrison rongeur forceps, one up-cutting jaws and one down-cutting jaws
1 Lillie sinus bone-nibbling rongeur

Precautionary Measures.—As for submucous resection.

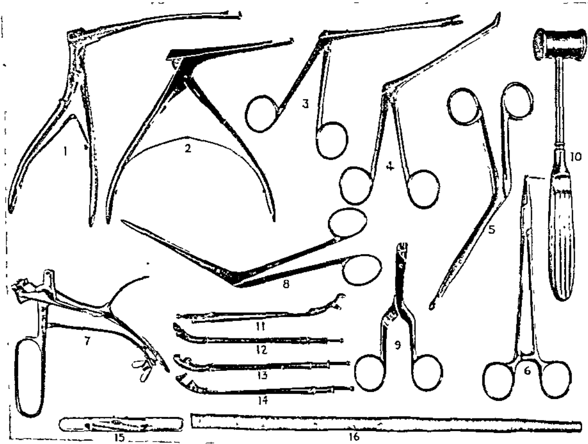


Fig 181 —Instruments for radical antrum and sinus operations—cont'd· *1-2*, Hajek-Kaffer sphenoid punch forceps, *3*, Blakesley septum bone-cutting forceps, *4*, Wilde ethmoid up-cutting forceps; *5*, Bruening septum-cutting forceps; *6*, needle holder and needle; *7*, universal handle, *8*, Knight polypus and turbinate forceps; *9*, Lutz septum ridge forceps, *10*, mallet; *11*, nasal sphenoid punch, *12*, ethmoid punch; *13-14*, Wagner antrum punches; *15*, suture, surgical gut; *16*, Penrose drain.

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table in a supine position (Chapter 4). The head is elevated by means of a headrest, and the shoulders are supported with a thin sponge-rubber pad or pillow. Suitable instruments must be available for use when administering a general or local anesthetic agent. Both sides of the front portion of the head, nose, and the face are cleansed. Castor oil is inserted into each eye. The patient is draped with sheets and towels as described for radical antrostomy.

Operative Procedure.—The following items, as shown in Figs. 178 to 181, should be available at the sterile field.

Steps	*Items*
1. A postnasal plug is inserted into the nasopharyngeal cavity.	1. Postnasal setup, Mayo-Pean curved hemostat, catheter No. 14 F, bayonet forceps, mouth suction tube and mouth gag, tongue depressor, gauze packing, if general anesthetic used (Fig. 178)
2 A curvilinear incision is made over the suspected frontal sinus, extending from the base of the nose through the eyebrow as far as the supraorbital notch.	2. Scalpel, sponges, Volkman retractors, hemostats
3. The superficial structures and periosteum are incised. Bleeding is controlled.	3. Elevator, scalpel, sponges, suction set, Kelly hemostats, ligatures, scissors
4. The periosteum is elevated. The sinus and supraorbital nerve are identified.	4. Retractors, suction set, submucous sponge and probe, Faulkner or Kelly antrum gouges, Freer submucous chisels, mallet
5 The pus and bone of the anterior wall of the frontal sinus are removed, except for that which forms the supraorbital ridge.	5. Nasal cutting forceps, chisels, mallets, Coakley curettes, suction sets, sponges, osteotome
6 Orifice of the sinus is opened and enlarged, thickened mucosa and polyps are curetted and removed.	6. Small gouge, rasps, cutting forceps, snares
7 The nasal frontal duct is identified and enlarged; the tract is explored and cleansed	7. Ring curettes, silver probes, antrum punches, cutting forceps, curettes
8 An ethmoidal incision may be made behind the nasal process of the superior maxillary bone, preserving the lacrimal duct The ethmoid cells are curetted.	8. Chisel, mallet, suction set, curettes
9. A drain is introduced from the sinus into the nose through the enlarged nasofrontal duct	9. Penrose drain, nasal dressing forceps, scissors, gauze compresses
10. The external wound is sutured. The wound and face are cleansed and dried.	10 Silk No. 4-0 swaged-on cutting-edge needles, compresses

Ethmoidectomy

Definition.—Removal of the diseased portion of the middle turbinate, opening and cleansing the ethmoid cells, and removal of the lesion in the nasal fossa.

Purpose.—To provide for drainage and aeration, to remove a lesion, and to control infection.

Precautionary Measures.—As for submucous resection.

Setup, Position, Skin Preparation, and Draping Procedure.—For the nasal route, an intranasal antrostomy setup is required, and the patient is prepared as for a submucous resection. For the external route, a Coakley modification for a frontal sinus operation is required, but only Steps 7 through 11 are included. Turbinate scissors, turbinate punches, and long ethmoid curettes are required. The patient is prepared as for an intranasal antrostomy.

Sphenoidectomy

Definition.—An opening into one or both sphenoid sinuses intranasally.

Precautionary Measures.—As for submucous resection.

Setup, Position, Skin Preparation, and Draping Procedure.—Intranasal antrostomy setup, adding sphenoid curettes, punches, and antrum rasps. Patient is prepared as for intranasal antrostomy (Chapters 3 and 4).

Operative Procedure.—Similar to antrostomy and ethmoidectomy.

Turbinectomy

Definition.—Anterior inferior turbinectomy—removal of the anterior end of the inferior turbinate. Inferior turbinectomy—removal of the greater part of the lower border of the inferior turbinate that has become hypertrophied. Anterior middle turbinectomy—removal of the anterior end of the middle turbinate body. Frequently, polyps also removed.

Purpose.—To provide for areation and adequate drainage and to relieve pressure against the floor of the nose.

Precautionary Measures.—As for submucous resection.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for intranasal antrostomy and for removal of nasal polyps.

Operative Procedure.—The major steps and items include the following:

Steps	*Items*
1. The nose is packed on all sides of the hypertrophied portion of the turbinate.	1 ½-inch petrolatum packing, cocaine, 4 per cent, Adrenalin, nasal forceps, scissors, cotton
2. An incision is made into the turbinate.	2. Nasal scissors, suction set, sponges
3. The affected portion of the turbinate is amputated and removed with forceps. Polyps are removed, cavity is packed, and face is cleansed.	3. Snare, scissors, suction set, nasal sponges and forceps, curettes, petrolatum packing, forceps, moistened sponges

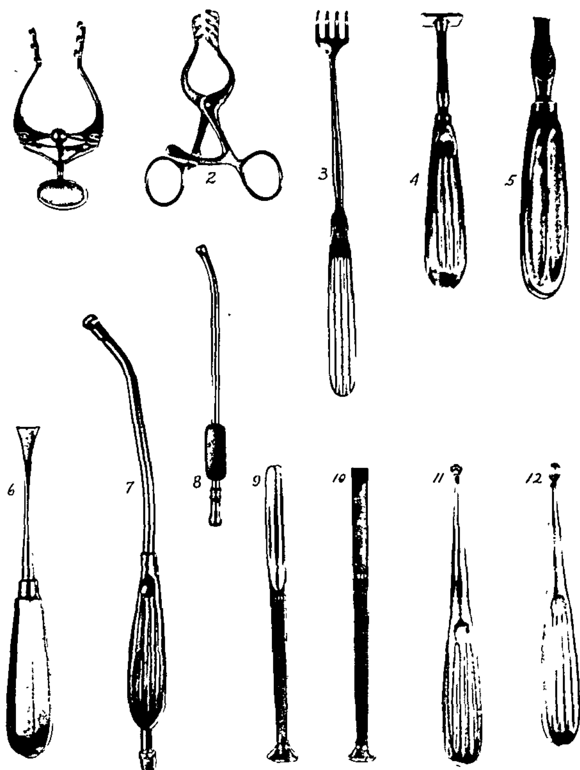


Fig. 182—Instruments for a simple mastoid operation. *1*, Jensen mastoid retractor; *2*, Weitlaner retractor, *3*, Volkman rake retractor, 4-pronged, dull points; *4*, Ballenger periosteotome; *5*, Jansen mastoid raspatory, *6*, Hopkins sharp periosteal raspatory; *7*, Yankauer throat suction, *8*, Van Eicken antrum wash tube No 11 F, *9*, Andrews mastoid gouge, *10*, Andrews mastoid chisel; *11*, Richards-Spratt mastoid open curette, *12*, Spratt mastoid closed curette.

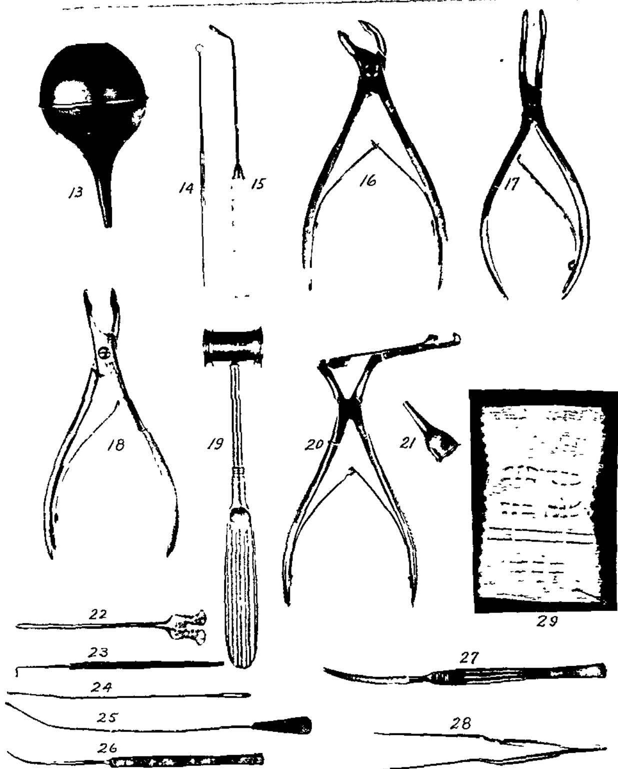


Fig 183—Instruments for mastoidectomy—cont'd· *13,* Aseptic ear syringe, taper tip; *14,* Buck ear curette, dull; *15,* Coakley sinus curette; *16,* Shearer chicken-bill rongeur forceps; *17,* Jansen rongeur forceps, *18,* Andrews-Hartmann rongeur forceps, *19,* mallet, *20,* Kerrison mastoid forceps; *21,* Gruber ear speculum; *22,* director; *23,* Allport mastoid searcher; *24,* probe with eyelet; *25,* Spencer ear probe, silver, for labyrinth exploration; *26,* Yankauer salpingeal ear probe; *27,* bistoury knife, *28,* Gruenwald nasal dressing forceps, *29,* needles (swaged-on sutures preferred).

Simple Mastoidectomy

Definition.—Removal of the mastoid cells, leaving the middle ear intact.

Purpose.—To treat an abscess formation in the mastoid cells.

Indications.—An abscess results from acute purulent otitis media that passes into the mastoid cells and infects them. When the drainage of the middle ear is obstructed, pain is more severe. The symptoms of acute mastoiditis are pain, pain on manual pressure over the mastoid process behind the ear, also swelling, rise in temperature, increased pulse rate, and increased white blood count.[5, 6]

Precautionary Measures.—The patient should be protected from muscle strain and pressure on the nerves and muscles. Strict asepsis must be carried out as for general surgery.[2, 6, 27]

Setup, as shown in Figs. 182 to 184, includes the following:

Instruments

2 Scalpel handles, Nos. 3 and 4, with blades Nos. 20, 15, and 10
1 Mayo scissors, curved
1 Suture scissors
2 Tissue forceps with one and two teeth
1 Tissue forceps without teeth
1 Wilde nasal dressing forceps
1 Gruenwald dressing and tissue forceps.
1 Weitlaner self-retaining retractor
1 Jansen or Allport mastoid retractor
1 Killian nasal speculum
1 Miller retractor
6 Kelly hemostats, curved
6 Mosquito hemostats, curved
4 Crile hemostats, straight
2 Allis forceps
2 Mayo-Pean hemostats, curved
6 Towel forceps
2 Needle holders
4 Sponge-holding forceps
1 Throat suction tip
1 Eicken antrum cannula
2 Adson or Frazier suction tubes, suitable sizes
2 Pieces of suction tubing, 36 inches
2 Ear irrigating bulbs
1 Shearer or Reiner chicken-bill rongeur forceps
1 Jansen rongeur forceps, small or large
1 Kerrison mastoid rongeur
2 Lempert or Buck ear curettes, suitable sizes
1 Hartmann ear forceps
1 Ballenger hand burr, if desired
1 Dean periosteotome, with curved denuding end
1 Jansen mastoid raspatory, beveled-edge dissector, slightly curved
1 Ballenger periosteotome
3 Alexander or Andrews mastoid chisels, suitable sizes
3 Alexander or Andrews gouges, suitable sizes
1 Mallet
1 Staeke facial nerve protector and guide
3 Spratt or Hibbs-Spratt mastoid curettes, suitable sizes
3 Richard mastoid curettes with fenestrated cup, suitable sizes
1 Andrews-Hartmann or Bane rongeur forceps

Other Items

2 Chromic gut No. 3-0 sutures swaged-on small ½-circle cutting-edge needles
2 Silk or nylon sutures No. 4-0 swaged-on ⅜-circle cutting-edge needles
2 Chromic gut No. 3-0 sutures swaged-on small ½-circle taper-point needles
Mastoid pack, including absorbent cotton; cotton applicators; 24 gauze sponges, 3 by 3 inches; 12 fluff gauze sponges; 1 mastoid dressing, desired type; 6 gauze compresses 4 by 4 inches; 4 cotton applicators; 2 gauze bandages, 2 inches wide; 1 regular or fenestrated draping sheet, 1 small regular sheet
1 Drain, Penrose tubing

Iodoform gauze packing, narrow width
Plain gauze packing, narrow width
Bone wax
Safety pin
Culture tubes
Adrenalin solution 1:1,000
3 Medication cups
Minor basin pack
Minor operating pack
Gown and glove sets
Skin preparation setup
Normal saline solution

Equipment for Operating Table

2 Oblong sponge-rubber pads
2 Small pillows
1 Head ring
1 Lifting sheet
1 Mastoid screen or infusion standard
Infant board, if necessary
Leg strap

Also

Head lamp
Sensitivity machine
Suction apparatus

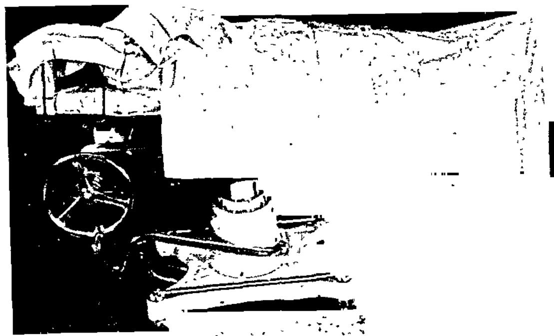


Fig 184 —Position for mastoid operations and some types of neck dissections, showing the mastoid screen draped with a towel

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table as follows: Place the patient in a supine position; then turn him slightly onto his unaffected side, pull underarm free from body, flex elbow slightly, and rest arms on the table. Turn the head to one side with affected ear uppermost and rest the head on a ring cushion. Place a pad under the neck and shoulder (Chapter 4). Place a second pad against the upper back region to stabilize him. Slightly flex the uppermost knee, straighten underleg, place a pillow between legs, and attach leg strap around table to secure legs.

The patient may be anesthetized before the proposed operative site is cleansed and shaved. The site prepared includes a circular area (about two inches in diameter) around the affected ear. In some cases the ear canal is

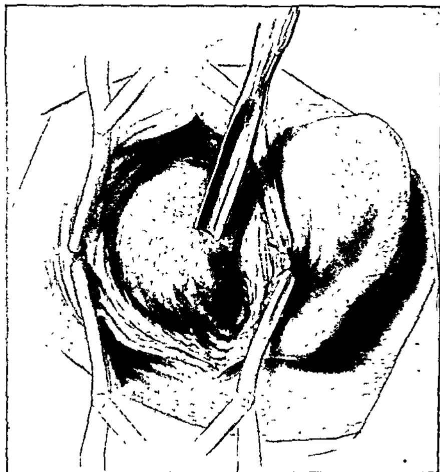


Fig 185—Mastoid operation. Beginning the bone exenteration with Alexander chisel. (From Loeb, H. W.: Operative Surgery of the Nose, Throat, and Ear, St. Louis, 1924, The C. V. Mosby Co)

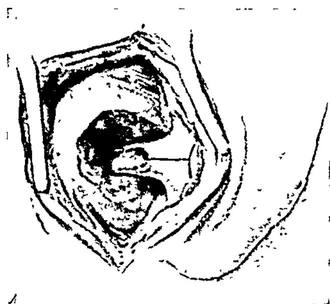


Fig. 186.—Mastoid operation Panse flap Incision. (From Loeb, H. W. Operative Surgery of the Nose, Throat, and Ear, St Louis, 1924, The C V Mosby Co)

irrigated, and the skin area dried and painted with a weak antiseptic. Routine skin preparation is carred out.

The patient is draped with a fenestrated sheet, which permits exposure of a triangular operative area, or he is draped with a large sheet and the head encircled in towels (Fig. 184).

Operative Procedure.—The steps and items as shown in Figs. 182, 183, 185, and 186, include the following:

Steps	*Items*
1. The incision is carried to the bone. Bleeding vessels are clamped and ligated.	1. Gauze sponges, scalpel with blade No. 20, Kelly hemostats, tissue forceps, ligatures, straight scissors
2. The periosteum is freed from the bone and retracted.	2. Gauze, periosteal raspatory, skin retractor, suction set, if desired
3. The muscle is cut and the wound edges are retracted.	3. Curved scissors, tissue forceps, self-retaining retractor
4. The bone is entered.	4. Chisels, gouges, mallet, and curettes; these items to be placed on the portable stand near the operative field
5. The margins and overhanging edges of bone are removed.	5. Rongeurs, bone wax, sponges, narrow plain packing strips wet with Adrenalin, dressing forceps, suction set and irrigation solution
6. The temporal bone is cleaned.	6. Rongeurs, curettes, normal saline irrigation, suction set
7. The mastoid cavity is opened, the sinus identified, and the antrum wall explored and cleaned.	7. Curettes, blunt-angled probes, fine curettes
8. The overhanging bone edges of the antrum are removed.	8. Chisel, rongeur forceps, mallet, Adrenalin packs
9a. The wound may be packed with iodoform gauze packing and drained.	9a. Narrow packing, nasal dressing forceps, scissors
9b. The wound is irrigated and the periosteum sutured.	9b. Irrigation set, normal saline solution, clean towels around wound edges, chromic gut sutures, tissue forceps, scissors
10. The skin is approximated; dressings and mastoid bandage are applied.	10. Silk or nylon sutures, gauze ring to fit the incision and ear, fluff gauze, compresses 4 by 4, and two gauze bandages, desired width

Radical Mastoidectomy

Definition.—Removal of the infected posterior bony wall of the external canal and mastoid cells, and making the middle ear and mastoid cavity into one.

Indications.—In the presence of chronic otitis media, the patient suffers from a chronic discharging ear, deafness, occasional pain in the ear and side of the head, and dizziness.

Setup, Position, Skin Preparation, and Draping Procedure.—Similar to procedures described for simple mastoid (Figs. 182 to 181). Instrument setup should include silver probes, ear curettes, sensitivity machine, Kerrison mastoid forceps, electric drill and burrs, and skin grafting setup, if needed.

Operative Procedure.—Through an incision made behind the ear, as for simple mastoidectomy, the cells are completely removed, and the middle ear and mastoid cavity are made into one cavity by removing the drum membrane, the small bones of the ear, and a portion of the posterior bony wall of the external canal. Then the eustachian tube is closed. The skin covering the external canal is incised to form a strip, which is laid against the bone so that it will become a lining for the new cavity. The cavity is packed and the wound sutured and dressed.

Tonsillectomy and Adenoidectomy

Definition.—Complete removal of the tonsils and adenoids by either sharp or blunt dissection method.

Indications.—Enlarged tonsils and adenoids usually are associated with the following symptoms: obstruction to breathing, poor general health, gland enlargement in the neck, pressure upon the eustachian tubes due to adenoiditis: sometimes deafness resulting from infection, chronic colds, bronchitis, and rheumatism also are associated with infected tonsils.[8, 14]

Precautionary Measures.—To provide operating efficiency, the surgeon needs adequate illumination, an effective suction set, properly prepared sutures and wire snares, suitable sponges, and sharp instruments. The mouth gag must be of a size to prevent injury to the patient's gums and lips and to avoid the danger of dislodging any teeth.[14, 16, 19]

Stainless steel snare loops, size 7, 8, or 9, should be cut in lengths of 5, 5½, or 6 inches, with each end bent back one-half inch. The wire loop in the snare must be large enought to pass over the handle of the tenaculum, but it must not be so large that its size prevents cutting entirely through the pedicle of the tonsil.

To ligate a bleeding vessel, a slip-knot ligature is used. The knot is made in the middle of a gut strand about 18 inches long.

After the tonsil has been removed, the tonsillar fossa is packed with a large sponge, which is usually attached to a string. A large sponge or tampon is preferred as it absorbs more blood than the small one, and if a large sponge becomes dislodged from the fossa (falling into the throat), it will not be drawn into the larynx Small bleeding points are sponged with small sponges attached to forceps.

After completion of the operation, the patient is turned onto his right side, with the right knee flexed. The head of the bed is elevated to prevent the mucus or blood from reaching the lung. If there is much postoperative bleeding, the patient may be placed in a prone position, with one large pillow under the chest

and another one under the forehead. A basin should be placed beneath the mouth to receive the expelled material. The patient's mouth should be kept open so that the blood and secretions will fall into the basin by gravity. By keeping the patient's mouth open and over the basin and his face down, the throat muscles are not used, thus aiding the vessels to clot. The prone position may be desired when the tonsillectomy has been performed with a local anesthetic.[11]

If immediate postoperative hemorrhage occurs, the patient may be returned to the operating room so that the surgeon can inspect the fossae, using a suction set. At this time the bleeding vessels may be ligated, or a dental plug saturated with bismuth subgallate may be inserted into the fossa, and pressure applied.

If secondary hemorrhage occurs after the fifth to the tenth day following surgery, the wound is inspected. Since the hemorrhage may be due to infection in the fossae, the retying of a vessel frequently is impossible. If the bleeding cannot be controlled by application of a chemical agent, such as bismuth subgallate powder, the patient is generally anesthetized and mattress sutures are inserted beneath the bleeding points and the deep muscles.

Setup includes the following:

Local Anesthetic Set

30 or 50 ml. of procaine solution, 1 per cent, and 5 or 8 ml. of Adrenalin solution 1:1,000
2 Luer-Lok syringes
3 Tonsil needles

General Anesthetic Set

Vapor hook
Pharyngeal tube

Instruments

Jennings, Wolf, Whitehead, or David mouth gag, child or adult size (Fig. 187)
1 Andrews or Weder tongue depressor, desired size
1 Towel clip, small
2 Yankauer throat suction tips, with rubber tubing (Fig. 187)
2 White, Lillie-Dean, Robertson, or Heis-Martin tenacula for seizing tonsil (Fig. 187)
1 Lillie or Hurd dissector and pillar retractor
2 Dean, Lillie, or Boettcher scissors, 7½ or 8 inches, curved
1 Mayo suture scissors
2 Lewis, Brown, or Eves snares
4 Snare wires, cut to fit snare, or La Force or Sluder tonsil guillotines or Beck-Mueller tonsillectome
4 Ballenger or Robb sponge-holding forceps
2 Dean hemostatic forceps 7¾ inches
2 Boettcher tonsil hemostats, slightly curved, 7¼ inches
2 Mayo-Pean hemostats, curved, 6¼ inches
2 Allis forceps for holding dental rolls
1 Coakley knot tier for slip-knot suture, if desired
2 Hartmann tonsil punches, suitable size, round or oval jaws
2 Coakley, Tydings-Allis, or Lewis tonsil pillar grasping forceps (Fig. 188)
1 Scalpel handle No. 7, with blade No. 10 or 12
1 Canfield or Lillie tonsil knife, single-edged
1 Robertson, Fisher, or Robb tonsil knife, double-edged
1 Boettcher, Lillie, or Lewis tonsil hook, two prongs
1 Laryngeal mirror
1 Abraham tonsil curette
1 Lewis tonsil screw, tenaculum
1 Needle holder, 7 inches

Adenoidectomy Set

1 Brown uvula retractor
1 Meltzer adenoid punch, suitable size

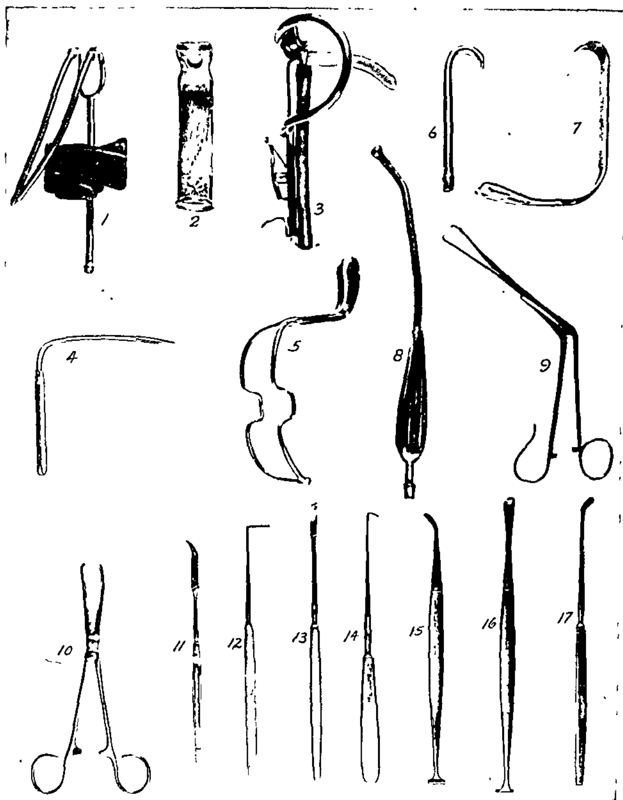


Fig 187 —Instruments for tonsil and adenoid operation *1*, Connell ether tubes; *2*, Connell pharyngeal tube; *3*, McIvor mouth gag; *4*, Bosworth tongue depressor; *5*, Jennings mouth gag; *6*, Gwathmey vapor hook; *7*, Weder tongue depressor; *8*, Yankauer throat suction tube; *9*, Tivnen tonsil-seizing forceps, *10*, White-Lillie seizing forceps, *11*, scalpel handle No 7 with blade No. 12; *12*, Glover tonsil knife; *13*, Dean tonsil knife, double-edged; *14*, Lillie tonsil hook; *15*, Hurd tonsil dissector and pillar retractor; *16*, Hurd pillar retractor; *17*, Hurd dissector.

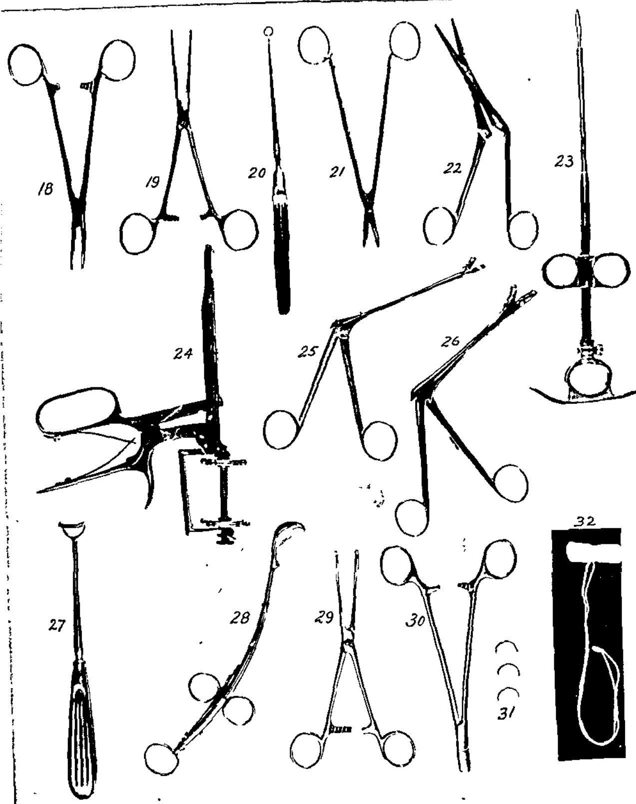


Fig 188—Instruments for tonsil and adenoid operation—cont'd *18*, Glover tonsil-pillar-grasping forceps, *19*, Lewis tonsil hemostat, *20*, Abraham tonsil crypt curette, *21*, Metzenbaum scissors, *22*, Knight angular scissors; *23*, Eves tonsil snare; *24*, LaForce tonsillectome; *25*, Hartmann tonsil punch, oval jaws, *26*, Hartmann tonsil punch, round jaws, *27*, Barnhill adenoid curette; *28*, *LaForce adenotome; 29*, *Ballenger sponge holding forcep; 30*, *Coakley needle holder; 31*, *tonsil needles*, ½-circle, cutting-edge and taper-point (swaged-on needles preferred); *32*, tonsil tampon

2 Vogel, Barnhill, or Jones adenoid curettes (Fig. 188)
2 Mack, Mueller, or LaForce adenotomes, suitable size

Sutures and Textiles

Plain gut No. 0 or 2-0 for free ligatures
Plain gut No. 0 swaged-on tonsil needle, ½-circle taper-point
Nose and throat linen pack containing:
  2 Regular sheets
  1 Portable slip-on cover
  4 Towels
  6 Gauze compresses, 4 by 4 inches
  10 Tonsil sponges
  4 Tonsil tampons with cord attached
Gown and glove sets

Also

Minor basin set
Antiseptic powder in spray, if desired
Normal saline solution
Specimen bottle



Fig 189.—Finger dissection of the tonsil Tonsil is grasped by forceps ready for the removal by snare or tonsillotome (From Loeb, H. W.: Operative Surgery of the Nose, Throat, and Ear, St Louis, 1924, The C V Mosby Co)

Position, Skin Preparation, and Draping Procedure.—When a general anesthetic is to be given, the patient is placed on the operating table or on his stretcher in a supine or slight Trendelenburg position. Two opened towels are placed under the patient's head. The top towel is wrapped around the head and secured by a safety pin or towel forceps, and the free ends of the towel are tucked on the head The patient is draped with a large sheet. A pillow is placed under the patient's shoulders to support and allow the head to fall slightly backward and downward (Chapter 4) When a local anesthetic is to be used, the patient is usually placed on the operating table in a sitting position, or a chair is used. The patient's face is cleansed with a weak antiseptic solution.

Operative Procedure.—The items, as shown in Figs. 187 and 188, are arranged on a portable stand.

Steps	*Items*
1. The mouth is retracted. Local setup or ether hook is placed in the corner of the mouth.	1. Syringes, needles, and anesthetic solution, if desired; self-retaining mouth gag, tongue depressor, suction set, and ether hook, if desired.
2. The tongue is retracted.	2. Tongue depressor
3. The tonsil is grasped, and the membrane incised.	3. Tonsil-grasping forceps, knife, sponges on holders
4. The tonsil lobe is freed from its attachments to the pillars. The tonsil is withdrawn. (Fig. 189.)	4. Separator and dissector, suction set, curved scissors, hemostats
5. The tonsil is removed by snare or Sluder method.	5. Grasping forceps, Eves snare or LaForce tonsillectome
6. The fossa is packed. Bleeding vessels are clamped.	6. Tampon on Mayo-Pean hemostats, suction set, hemostats
7. The adenoids are removed.	7. Adenotome or curette, moist gauze compress
8. The bleeding points are ligated.	8. Suture ligature or free tie on a hemostat, scissors
9. The mouth gag is removed, the throat is suctioned, and the face is cleaned.	9. Moist compresses, head of patient turned to one side; emesis basin

Partial Thyroidectomy

Definition.—Removal of part of the thyroid gland.

Anatomy.—The thyroid gland, consisting of a right and a left lobe, is united by a middle portion called the isthmus, which is situated near the base of the neck and anterior to the trachea. The skin platysma and ribbon muscles overlie it. The main blood supply comes from the superior and inferior arteries on either side [4, 13, 30-33]

Setup.—The standard setup should meet the approval of the attending physicians, and it should be evaluated periodically by the representative committee (Chapter 4). The items, as shown in Fig. 190, include the following:

Instruments

2 Mayo-Collins retractors
2 Roux retractors
2 McBurney or Greene retractors
2 Lahey retractors, right-angled
2 Volkman rake retractors, duel 4-pronged, if desired
1 Crotti or Beckmann self-retaining thyroid retractor
4 Roberts or Foerster sponge-holding forceps
4 Bozeman sponge forceps
10 Towel forceps
3 Scalpel handles, 2 No. 4 with blades No 20, and 1 No. 3 with blade No. 10
3 Tissue forceps with one and two teeth—2, 5½; and 1, 4½ inches
2 Tissue forceps without teeth, 5½ and 7 inches
24 Skin clips, desired width, and clip holders for securing skin towels, if desired
3 Needle holders
2 Lahey ligature needles or carriers
1 Mayo scissors, curved

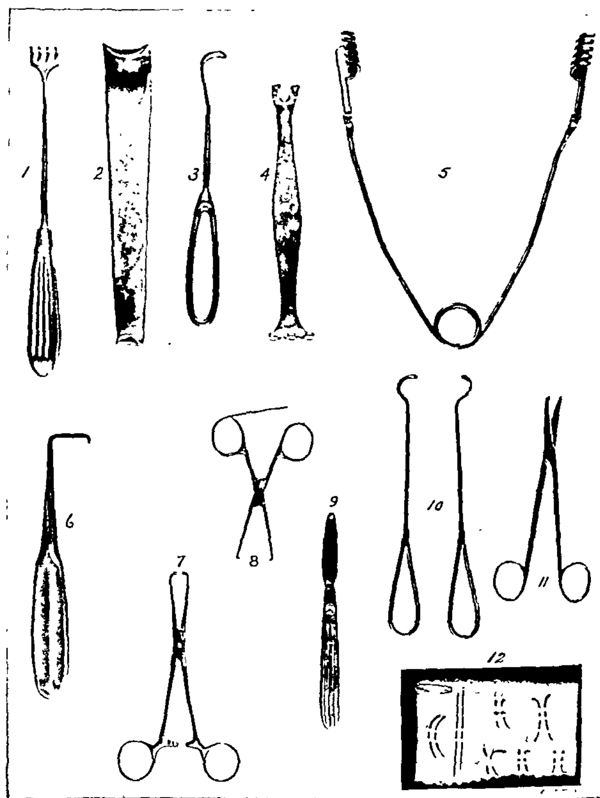


Fig 190—Instruments for thyroid operation: *1*, Volkman rake retractors, dull points; *2*, Roux retractor, *3*, McBurney loop retractor, *4*, Mayo-Collins retractor; *5*, Lahey self-retaining retractor; *6*, Lahey thyroid pole retractor; *7*, Lahey vulsellum forceps; *8*, Kocher muscle forceps; *9*, Kocher bronchocele sound, *10*, Lahey ligature needle, right and left, *11*, Lahey goiter scissors; *12*, needle set (swaged-on sutures preferred).

1 Suture scissors, straight
1 Lahey goiter scissors
1 Metzenbaum scissors
36 Crile hemostats, straight
6 to 12 Kelly or Lahey hemostats, curved
4 Kocher or Mastin muscle clamps, if desired
2 Ochsner forceps, curved
4 Bainbridge goiter hemostatic forceps, if desired
4 Allis forceps
4 Lahey vulsellum forceps
2 Tenacula, sharp thin hooks
1 Probe and grooved director

Drains

1 Piece Penrose tubing, 3/8 inch wide and 8 inches long, or silkworm gut twist

Sutures

Surgical gut plain No. 2-0
Surgical gut chromic Nos. 0, 2-0, and 3-0
Silk or cotton Nos. 2-0, 3-0, and 4-0
Skin sutures, monofilament nylon No. 5-0, or metal skin clips
Swaged-on needles and sutures desirable, or
2 Mayo needles No. 3 or 4, 1/2-circle taper-point
2 Surgeon's regular needles, No 10 3/8-circle, taper-point
2 Murphy needles No. 4 or 3 or Ferguson No. 7 or 10, 1/2-circle taper-point
4 Keith needles, straight

Textiles

1 Major operating linen pack (Chapter 2)
1 Gown pack
1 Glove set
1 Thyroid or neck pack containing:
  2 skin towels or pads
  48 Gauze sponges, desired types and sizes
1 Dressing set, desired type
1 Fenestrated sheet, or 4 regular sheets—3 small and 1 large size for draping patient
6 Laparotomy pads with tapes attached, 6 by 6 inches

Other Items

Infusion solutions and sets
Skin preparation setup
Equipment for operating table including;
  2 Pillows
  1 Sandbag, if desired
  1 Footpiece and pad
  1 Leg strap
  1 Anesthetist's screen, desired type
Infusion standard
Emergency cardiac arrest setup
Tracheostomy set
Distilled sterile water or normal saline solution

Position, Skin Preparation, and Draping Procedure.—The articles required for positioning the patient include the leg strap, an anesthetist's screen or two standards or supports, one small folded sheet or pad, footpiece and protective pad, armrest and restraint straps or gauze bandage, and one pad for the lumbar region. Before the patient arrives, the footpiece is attached to the table and a protective pad placed on the table against the footpiece. Other pieces of equipment are ready for use and the lamp is adjusted over head of table (Chapter 4). The patient is placed in a supine position, with his neck slightly hyperextended to provide a straight line from chin to shoulders. The table is slanted downward for the convenience of the operators.

In preparing the patient for the operation, the worker carries out the following steps: Greet the patient by name. Check his chart according to hospital rules and policy. Lock the stretcher and transfer the patient to the operating table so that his shoulders are just below the upper break of the table. Attach the leg strap and adjust the footpiece, if necessary. Unfasten his gown.

Stay with him until he has been anesthetized; then place a small folded sheet or pad under his head and shoulders, secure his arms in the folds of the lift sheet, unfasten the leg strap (if desired), and switch on the operating table lamp.

The proposed operative site is cleansed in the usual manner (Chapter 3). *The area includes the anterior neck region, lateral surfaces of the neck down* to the outer aspects of the shoulders, and the upper anterior chest region. The table is raised or lowered to suit the surgeon's convenience, and the lamp is focused on the operative site.

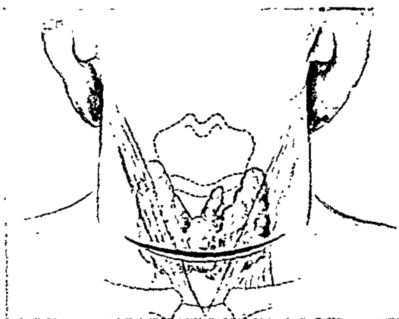


Fig 191 —Relationship of incision to thyroid gland. Incision is made through the skin and platysma muscle. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N. J.)

The patient then is draped with sterile towels and sheets as follows:

Place the first towel transversely, allowing its folded side to fall at the base of the neck and the remaining part across the upper chest region. Place *a second towel (folded longitudinally) across the face so that the folded edge is* at a level with the chin Place the folded edge of the third and fourth towels on an imaginary line extending from the outer aspects of each shoulder to the midline of the upper chest. (Figs. 192 and 193.) Place a large fluffed compress or small crushed towel snugly against each side of the neck; then drape the fenestrated sheet over the patient. This sheet is prepared and opened as described for the laparotomy fenestrated sheet (Chapter 4). Place the folded sheet so that the opening in it falls directly over the proposed operative site outlined by the towels. Drop the folds over the sides of the table, then place the gloved hands under the top fold, grasp the sheet, and open the upper portion of the sheet upward over the anesthetist's screen. Open the lower portion downward over the foot of the table.

If a tape is attached at each end of the opening in the sheet, grasp the end of each tape with a forceps and insert them through the opening so that they fall at each side of the patient's head. The circulating nurse grasps the forceps, brings the tapes around the patient's head, and secures the ends with a forceps. These tapes keep the edges of the opening in the sheet against the proposed operative site. If the top of the sheet is secured to upright supports situated near the head of the table, the two loops of cotton tape which have been sewn to the sheet are secured to the supports or the standard poles.



Fig 192—The proposed operative site has been outlined by four sterile towels, and a fluffed large pad is being placed at each side of the neck. In positioning the foundation towels, the draper extends his arms and keeps his hands away from the patient and table.

To drape the patient, using regular sheets, the steps include the following: The anesthetist slightly lowers the headpiece of the table, then extends his arms and holds the patient's head away from the table. One gowned and gloved operator stands near one side of the table and grasps one end of a small fan-folded sheet, and the operator on the other side grasps the other end of the sheet. They place the top folds under the patient's neck and open them over the shoulders and each side of the anterior chest, and then drop the lower portion of the sheet over the head of the table. The patient's head is placed on the table, the headpiece raised, and the anesthetist's screen attached.

The gowned and gloved operator places a large fan-folded sheet across the patient. The top fold of the sheet is placed at a level just above the base of the neck, and the lower folds are opened downward over the patient's feet. A second small sheet is placed transversely over the patient with its top end at a level with the upper edge of the large sheet on the patient. A small center pleat is made at the top edge of the small sheet to provide for a sufficient opening. The top fold of the small sheet is secured to the two undersheets; the folds of sheets are secured with towel forceps at points over the outer aspects of the neck, shoulders, and sides of the anterior chest region. The top small sheet is grasped and turned back over the anesthetist's screen so that only the proposed operative site is exposed.



Fig 193—The patient has been placed in a supine position, with the table slanted downward for the convenience of the operators The fenestrated thyroid sheet has been draped over the patient and the upper end of the sheet secured to standards.

Incisional Approach.—Low "collar" incision following the impression on the skin, which has been previously made by a thread of suture material.

Operative Procedure.—The items needed during the operation are listed opposite each operative step.

Steps	*Items*
1. The incision is carried down through the platysma (Fig. 191).	1. Gauze compresses, scalpel, 2 tissue forceps, Crile hemostats, curved Mayo scissors, basin for discarded instruments
2. The upper skin flap is elevated; tissue is dissected under the flaps.	2. Lahey forceps, curved scissors, tissue forceps, scalpel, Crile hemostats
3. The bleeding vessels are clamped and ligated.	3. Surgical gut plain No. 2-0, chromic No. 3-0, or silk No. 4-0, straight scissors, moist and dry sponges.
4. The lower flap of the skin is retracted and dissected away from the underlying fascia. Bleeding vessels are ligated.	4. Scalpel, curved scissors, gauze sponges, Crile hemostats, tissue forceps, plain No. 2-0, chromic gut 3-0, or silk No. 4-0
5. The skin towels are applied to skin edges of the upper and lower flaps. Towels overlap at the ends of the incision and are held in place with hemostats. Upper end of the skin towel on the upper flap is fastened to the thyroid sheet.	5. Skin towels, 8 by 12 inches, made from four plies of gauze and sewn together, towel clamps, 2 tissue forceps, 2 Mayo-Pean hemostats, 2 towel clamps
6. The superior and inferior flaps are retracted; all bleeding vessels are clamped and ligated.	6. Self-retaining retractor or Lahey vulsellum forceps
7. A vertical incision is made in the middle cervical fascia. The incision is continued down to the capsule of the gland; the wound edges are grasped.	7. Tissue forceps, scalpel, Crile hemostats, grooved director, curved Metzenbaum scissors, Roux retractors
8. The middle cervical fascia is retracted laterally.	8. McBurney or Roux retractors
9. Frequently, the ribbon muscles are clamped, cut across, and retracted to increase the exposure.	9. 2 Ochsner forceps, scalpel, 2 Lahey forceps; clamps remain on the muscle and Lahey forceps retract the clamps and muscles
10. Generally, the right lobe is operated upon first because the operator usually stands on the right side of the table, and because the lobe on the right side is usually the larger one.	
11. The thyroid lobe is freed. This necessitates clamping and dividing the lateral veins, which are then ligated.	11. Scalpel, tissue forceps without teeth, Metzenbaum scissors, Crile hemostats, Lahey forceps
12. The right superior pole is exposed.	12. Lahey pole retractors, sponges on holders

Steps	*Items*
13. The superior thyroid vessels are divided and doubly ligated (Fig. 194).	13. Crile or Mayo-Pean hemostats, tissue forceps with teeth, Lahey aneurysm needle threaded with silk No. 2-0 or chromic gut No. 0 for ligatures, scissors
14. The upper pole of the gland is delivered out of the wound and freed.	14. Lahey forceps, Metzenbaum scissors, Crile hemostats, 2 Mayo-Pean hemostats
15. Often the main trunk of the inferior artery is ligated, usually without dividing it (Fig. 194).	15. Metzenbaum scissors, tissue forceps with teeth, Crile hemostats, chromic gut No. 2-0 or silk No. 2-0 or 3-0 (suture ligature) threaded or swaged-on intestinal needles ½-circle No. 1¼, scissors
16. The right lobe is further mobilized, the isthmus is divided, exposing the front of the trachea, and a Kelly hemostat is used to separate and spread the tissue from the trachea.	16. Metzenbaum scissors, tissue forceps, scalpel, Kelly hemostat, Crile hemostats, ligatures chromic gut No. 2-0 or silk No. 4-0
17. Small hemostats are placed on the lobe at the site of intended resection; then the specimen is removed.	17. Crile hemostats, scalpel, scissors, specimen basin, moist sponges, small pads
18. The clamped blood vessels on retained portion of the gland are ligated. Remnant of the lobe is folded over by sutures.	18. Chromic gut No. 2-0 or silk No. 4-0, straight scissors, sponges, interrupted sutures, chromic gut No. 2-0 or silk No. 4-0 threaded or swaged-on ½-circle Murphy needles No 3, tissue forceps, scissors
19. The left lobe is then resected in a similar manner.	
20. A drain may be inserted.	20. Penrose drain
21. The pretracheal muscles, if they have been divided, are approximated with mattress sutures over the clamps. Skin towels are removed.	21. Chromic gut No. 0 or silk No. 3-0 threaded or swaged-on Murphy needles ⅜-circle taper-point, No. 1 needle holder, tissue forceps, scissors
22 The wound edges are cleansed; subcutaneous tissue is approximated (Fig. 194).	22. Wound edges cleansed with an antiseptic; field draped with a clean towel; interrupted sutures plain No. 2-0, chromic gut No. 2-0 or silk No. 4-0 threaded or swaged-on Murphy needles ½-circle No. 3, tissue forceps, scissors
23. The skin edges are closed; dressings are applied to the wound.	23. 2 tissue forceps, silk No. 4-0 swaged-on needles or Keith needles. Crile hemostats, scissors, Michel clips and holders, skin hooks and forceps, compresses 4 by 8 inches

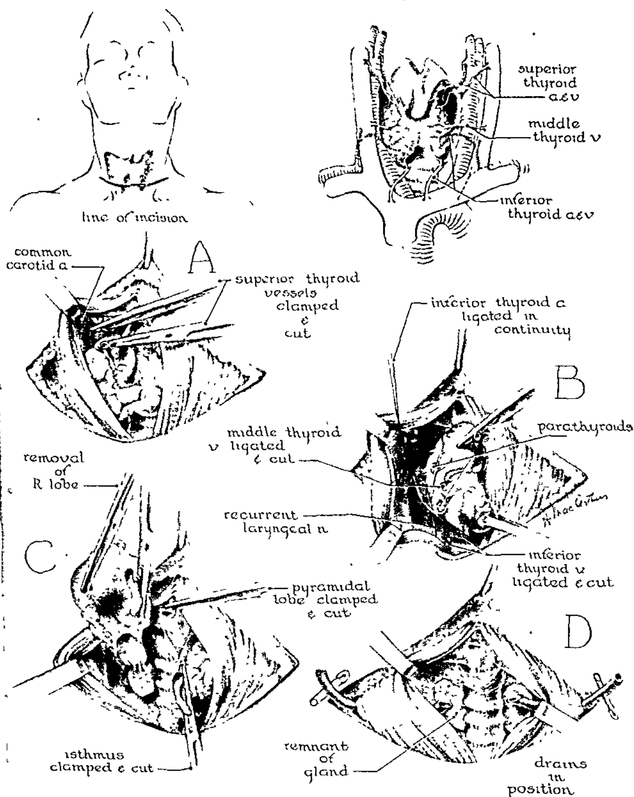


Fig 194 —Steps of thyroidectomy. (From Moseley, H F. Textbook of Surgery, St. Louis, 1955, The C V. Mosby Co)

A thyroid collar consists of one strip of adhesive, 1½ inches wide and 28 inches long, and a folded compress, which is placed on the center part of the adhesive strip to protect the hair. The strip is brought from the back of the neck to the front of the neck, allowing the ends to cross over the chest of the patient. Additional narrow strips of adhesive may be needed to reinforce the collar over the wound.

Tracheostomy

Definition.—Through a midline incision in the neck situated below the cricoid cartilage and extending from the thyroid notch to the suprasternal notch, the trachea is opened and a cannula inserted.[13,23,32,34-40]

Purpose.—To remove the danger of asphyxia due to a laryngeal spasm or a tracheobronchial obstruction and to supply air to the bronchi and lungs.[34,36,38] (Fig. 195.)

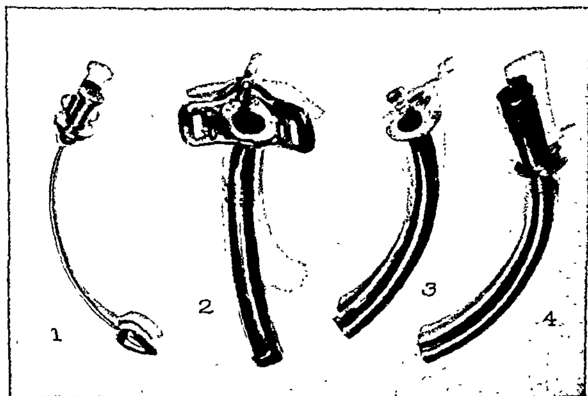


Fig 195—Tracheostomy tubes including *(1)* obturator *(2)* outer cannula, *(3* and *4)* inner cannulas (From Moseley, H. F Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co)

Setup.—The standard setup should be kept sterile, ready for immediate use and should include the following:

Instruments

2 Scalpels with handles No. 3 and blades Nos. 10 and 15
1 Miller or Volkman rake retractor
1 Greene retractor, if desired
2 Little retractors
1 Throat suction tube
1 Adson suction tube
1 Rubber suction tube, 36 inches
2 Tissue forceps with teeth
2 Tissue forceps without teeth
1 Mayo scissors, curved
1 Suture scissors

1 Metzenbaum scissors
6 Kelly hemostats, curved
4 Crile hemostats, straight
2 Mayo-Pean hemostats
2 Sponge-holding forceps
2 Needle holders
1 Jackson tracheal retractor, double-ended
1 Jackson dilator or Jackson laryngofissure dilator, double-ended
1 Jackson bistoury tracheal knife, curved, blunt edge
2 Tracheotomy tubes, desired size, No. 2, 3, 4, 5, or 6
1 Catheter No. 14 or 16 F
2 Cotton tapes, each 1/4 inch wide by 12 inches
Local syringe set and 1 or 2 per cent procaine solution
Adrenalin solution 1:1,000

Textiles

Minor throat pack
Minor operating pack
Glove set
Gown pack
Minor basin set

Sutures

Surgical gut, plain No. 3-0, free ties
Surgical gut, chromic No. 3-0, swaged-on intestinal needle 1/2-circle, taper-point
Silk No. 4-0, swaged-on cutting-edge needle, 3/8-circle, or surgeon's needle No. 12

Also

Cardiac arrest setup (Chapter 10)
Oxygen and Pentothal sodium setup
Suction apparatus
Skin preparation set

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table or stretcher in a supine position, with a small thin pad under the shoulders to elevate the trachea. If the patient is extremely dyspneic, the head is not extended until the operator is ready to open the trachea (Chapter 4). Routine skin cleansing is carried out (Chapter 3). The patient is draped with a fenestrated sheets as described for thyroidectomy

Operative Procedure.—The items must be available on the sterile portable stand before the patient arrives, and the suction apparatus must be in working order. The steps and items for a tracheostomy include the following:

Steps	*Items*
1. The operative site is injected with procaine solution. An incision is made through the skin of the superficial fascia (Fig 196). Superficial bleeding vessels are clamped and ligated.	1 Local needles, hypodermic needle, and fine injection needles, scalpel, Crile hemostats, plain gut No. 3-0 ligatures, skin retractors
2. The incision is deepened in the midline down to thyroid, cricoid, and tracheal cartilages A dry wound is maintained and the external perichondrium is preserved.	2. Retractors, scalpel, straight scissors, gauze sponges
3 The muscles and the isthmus of thyroid are divided and retracted. Bleeding vessels are clamped and ligated (Fig. 197).	3. Mayo-Pean or Crile hemostats, straight scissors, Jackson hemostats, retractors
4. The trachea is grasped and elevated with tenaculum, and then incised.	4 Tenaculum, scalpel, Jackson dilator, pointed curved bistoury

Steps	*Items*
5. The tracheal incision is spread apart and a cannula inserted through the tracheal opening. The shield of the cannula protrudes slightly from level of skin.[38]	5. Trousseau dilator, desired tracheotomy tube with pilot which is quickly removed, catheter attached to suction machine to aspirate secretions
6. The wound is loosely and partially closed around the cannula.	6. Chromic gut No. 3-0 threaded on curved taper-point needle, and silk No. 4-0 attached to cutting-edge curved needle
7 Dressings are applied astride the cannula behind the shield. The tube is tied in place with tapes. Patient is transferred to bed and then taken to recovery room.	7. Dressings, split halfway, and cotton tape

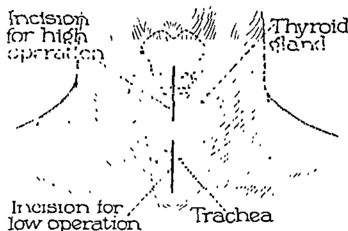


Fig 196 —High and low incisions are shown for tracheostomy and their relationship to the underlying structures (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N J)

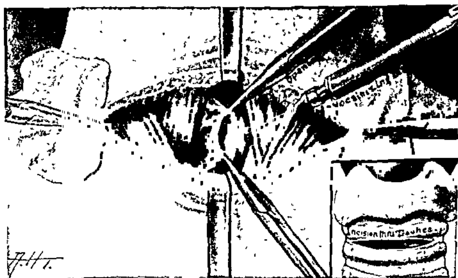


Fig 197 —Tracheotomy. Incision through thyroid gland and trachea. (From Loeb, H W.: Operative Surgery of the Nose, Throat, and Ear, St Louis, 1924, The C V. Mosby Co)

Bedside sterile tray should contain the following items: gloves, gauze, scissors, probe, two hemostats, Trousseau dilator, an exact duplicate of the cannula used, an infant catheter, distilled water to moisten catheter; also suction machine. Tonsil wire should not be used to clean the tubes as it roughens the thin edge of the inner end of the cannula.

Excision of Thyroglossal Duct Cyst

Definition.—Removal of the cyst and any remaining remnants of the duct up to the base of the tongue.[2, 31]

Setup, Position, Skin Preparation, and Draping Procedure.—As for the thyroidectomy (except for fewer hemostats) and the following:

- 1 Periosteal elevator, slightly curved and narrow
- 1 Jansen raspatory, straight and narrow
- 1 Jansen raspatory, curved and narrow
- 1 Hartmann rongeur forceps, curved, narrow jaws
- 2 Nasal bone-cutting forceps, narrow jaws
- 6 Mosquito hemostats, straight
- 1 Hypodermic syringe and needle, and methylene blue solution
- 1 Side mouth gag
- 1 Silkworm-gut twist or Penrose drain, narrow width

Incisional Approach.—A transverse incision about 2½ inches in length is made at the upper level of the hyoid bone. If a fistula is present a narrow elliptical incision is made.

Operative Procedure.—Items should be available for the various steps as follows:

Steps	*Items*
1-3. The skin and platysma are incised. The skin edges are protected and then retracted.	1-3. Similar to procedure described for thyroidectomy
4. The muscles attached to the center of the hyoid bone are divided.	4. Crile hemostat, curved scissors, knife, elevator, small sponges
5. The cyst is freed from the surrounding tissue up to the hyoid bone through which the tract may pass.	5. Curved Metzenbaum scissors, tissue forceps, small sponges on holders; methylene blue injection in some cases
6. The center of the hyoid bone may be removed.	6. Raspatory, rongeur, bone cutting forceps
7. Then dissection is continued into the base of the tongue toward the foramen cecum.	7. Same as Step 5; sponges on holders
8. The surgeon may place his finger in the mouth to determine the extent of the dissection.	8 Mouth gag, sponge on holder
9. The tissue of the tongue is closed.	9 Surgical gut plain No. 2-0 or chromic No. 2-0 swaged-on ⅜-circle taper-point needle, tissue forceps, scissors, Crile hemostat

Steps	*Items*
10. The tissue over the ends of the hyoid bone is sutured.	10. Interrupted sutures, chromic No. 2-0 swaged-on Murphy needle No. 3 or 4, needle holders, tissue forceps
11. A small drain is usually inserted.	11. Narrow Penrose drain or silkworm-gut twist
12. The skin edges are sutured. Dressings are applied to the wound surface.	12. Compresses, interrupted silk sutures or Michel clips as for thyroidectomy closure

Laryngofissure

Definition.—Removal of an intrinsic tumor or a circumscribed cancer in the interior larynx when one cord is involved.[21-23,27,41,42]

Setup.—The standard setup should be approved by the attending physicians of the otolaryngology service. The items should include the following:

Instruments

- 2 Volkman 4-pronged retractors, sharp and dull
- 2 Roux retractors, if desired
- 2 McBurney retractors, small
- 1 Lukens thymus retractor
- 1 Chevalier Jackson or Freer tenaculum retractor
- 2 Little retractors
- 1 Curette, fine-pointed
- 8 Backhaus towel forceps, 3 inches
- 4 Foerster sponge-holding forceps, 9¾ inches
- 1 Foerster sponge-holding forceps, if desired, 5½ inches
- 6 Pean sponge-holding forceps
- 2 Crile-Wood heavy needle holders, 6 inches
- 2 Lahey aneurysm needles, right and left
- Antrum or laryngeal tubes with rubber tubing
- 1 Throat suction tube and tubing
- 1 Piece heavy alloy steel wire for cleaning suction tubes
- 1 Laryngeal angled dressing forceps
- 2 Skin hook retractors
- 3 Tissue forceps without teeth—2, 4½ inches; 1, 5½ inches
- 3 Tissue forceps with teeth—2, 4½ inches; 1, 5½ inches
- 1 Jackson or Gruenwald laryngeal forceps
- 1 Scalpel with handle No. 4 and blade No. 20
- 2 Scalpels with handles No. 3 and blades Nos. 10 and 15
- 1 Mayo scissors, heavy, curved right or left
- 2 Mayo scissors, curved on flat, 5½ inches
- 2 Mixter or Metzenbaum scissors—1, 4½ inches; 1, 6½ inches
- 1 Suture scissors
- 1 Crile-Wood Mayo, light needle holder, 6 inches
- 1 Chevalier Jackson curved needle holder, if desired
- 12 Crile hemostats, straight
- 12 Kelly hemostats, straight
- 12 Kelly hemostats, curved
- 6 Mosquito hemostats, curved
- 4 Allis forceps
- 4 Mayo-Pean or Rochester hemostats
- 4 Kocher hemostats
- 2 Lahey forceps, if desired
- 1 Tumor-grasping forceps, cupped tip
- 1 Laryngofissure saw or heavy curved turbinatome scissors
- 1 Freer elevator, curved
- 1 T[illegible]
- 1 Tracheostomy set

Other Sterile Items

3 Medication glasses, labeled for solutions
Novocain solution, 1 per cent
Cocaine solution, 10 per cent
Pontocaine solution, 2 per cent
Adrenalin solution, 1:1,000
Thromboplastin or fibrin gauze, or similar substance
Petrolatum mesh gauze
Plain gauze packing, 1 inch wide
Iodoform gauze packing, 1 inch wide
Infusion setup
Local syring set
Gown pack
Glove set
Thyroidectomy pack
Thyroidectomy suture set
Major operating pack (Chapter 2)
Skin preparation setup (Chapter 3)

Unsterile Items

Suction machine
Infusion standard
Resuscitation setup

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table in a slight upright or reverse Trendelenburg position (Chapter 4). The proposed operative site is cleansed and the patient draped with sheets as for thyroidectomy.

Summary of Operative Procedure.—

1. The operative site is infiltrated with a local anesthetic solution.

2. An incision is carried through the skin, the platysma muscle, and the superficial fascia; the ribbon muscles are separated down to the tracheal fascia and retracted, similar to a tryroidectomy procedure (Fig. 196).

3. The isthmus of the thyroid is exposed and dissected free from the trachea; then it is clamped and cut to expose the first three rings of the trachea.

4. The trachea is opened at a point below the first ring and a tracheostomy tube is inserted.

5. The thyroid cartilage is exposed, and the perichondrium is elevated from the midline over the right ala.

6. The interior of the larynx is opened by means of a Struyker saw, the affected vocal cord and band separated from the cartilage of the thyroid, and the lesion extending down to the vocal process removed intact.

7. Bleeding is controlled; the wound is closed in layers as in thyroidectomy; petrolatum gauze dressing is applied, and impregnated packing of the desired kind is placed around the tracheostomy wound.[41, 44]

Laryngectomy

Definition.—Complete removal of the larynx, the thyroid and cricoid cartilages, and the epiglottis.[3, 23, 41, 44]

Purpose.—To remove a cancerous lesion and to prevent the cancer cells from spreading.

Sterile Setup.—As described for laryngofissure, plus extra hemostats, electric-driven saw, if desired, and regular sheets for draping the patient.

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table in a supine position (Chapter 4). A slight reverse Trendelenburg position may be used as for thyroidectomy. The proposed operative site may be infiltrated with Novocain solution prior to draping the patient with

sterile sheets. The patient's head is wrapped in a towel and his face covered with a moistened large dressing.

Summary of Operative Procedure.—

Steps	*Items*
1. A midline incision is made from the hyoid bone to the suprasternal notch. The thyroid isthmus is exposed and divided.[42]	1. As for thyroidectomy
2. The sternohyoid and thyrohyoid muscles are separated. The thyroid cartilages are dissected from each other. Bleeding vessels are ligated.	2. Small retractors, fine dissecting instruments and hemostats, suction set, and sponges
3. The inferior constrictor muscles of the pharynx are divided and the inferior laryngeal vessels ligated. The hyoid bone may be partially or completely resected.	3. Elevators, rongeurs, and blunt dissection instruments
4. The trachea is divided and may or may not be sutured. The larynx is elevated and thyroid cartilages are dissected free.	4. Tracheal cannula and suction set, elevators, dissecting scissors, hemostats, silk sutures
5 The superior laryngeal vessels are ligated.	5. Silk or chromic gut sutures
6. The pharynx is opened and the larynx is removed. The pharynx is closed	6. Heavy shears, interrupted fine chromic gut or stainless steel wire sutures, needle holder, tissue forceps
7 The wound is closed; drainage is established, and the wound is dressed.	7. Chromic gut or silk sutures, tracheal cannula and catheter, and gauze dressings

Partial Glossectomy

Definition.—Excision of a portion of the tongue for the treatment of a most malignant form of cancer of the oral cavity.[12,27,41]

Anatomy.—The tongue is a firmly movable muscular organ attached to the floor of the mouth, the mandible, and the hyoid bone. The tongue has a tip, base, dorsum, and two sides. It lies below the palate region, above the floor of the mouth, and in front of the pharynx (Fig. 194.) The superior portion is free and mobile It is covered by mucous membrane continuous with the lining of the mouth. The tongue receives its blood supply from the branches of the lingual, facial and pharyngeal arteries.[2,3,41,42]

***Setup.**—The items include the following:*

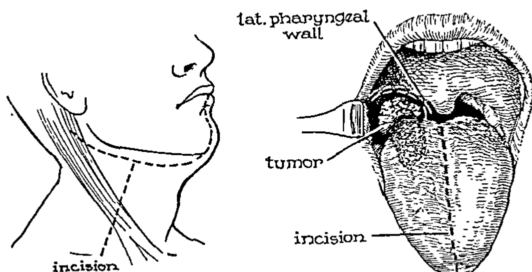
Instruments

2 Bosworth and Wider tongue depressors

1 Mouth gag, desired type

1 Catheter No. 14 F

1 Metal ether hooked tube, if desired



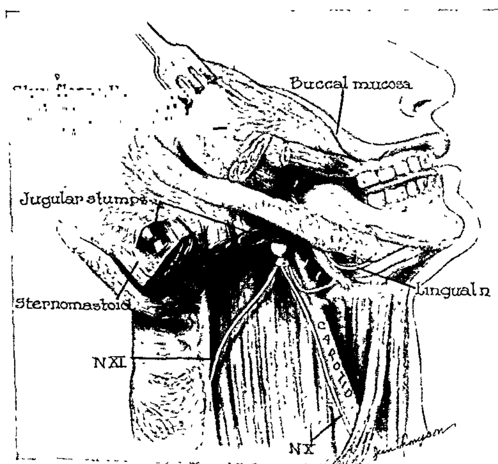


Fig. 198.—*A*, Hemiglossectomy. *B*, Radical neck dissection. (From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co.)

2 McBurney retractors
2 Cheek retractors or small Deaver retractors
2 Right-angled, small retractors
3 Scalpels with handles Nos. 4, 3, and 7, blades Nos. 20, 10, and 15
3 Tissue forceps with teeth—1, 5½ inches; 2, 7 inches
3 Tissue forceps without teeth—1, 5½ inches; 2, 7 inches
2 Nasal dressing forceps
1 Tonsil dissecting scissors, curved, 7¼ inches
1 Mayo scissors, curved, 7 inches
2 Mayo scissors, curved, 5½ inches
1 Mayo scissors, straight, 5½ inches
1 Suture scissors
2 Hegar or Crile-Wood needle holders, heavy, 8 inches
1 Crile-Wood needle holder, 5½ inches
1 Aneurysm needle or carrier
4 Foerster sponge-holding forceps
6 Towel forceps
2 *Throat tubes and rubber suction* tubing
6 Mayo-Pean hemostats, curved, 6½ inches
6 Crile hemostats, straight
4 Allis forceps
2 Rochester-Carmalt hemostats, 8 inches, if desired
3 Tonsil hemostats
Electrosurgical unit with coagulation and cutting electrodes

Other Sterile Items

1 Minor operating pack
1 Glove set
1 Gown pack
2 Regular sheets—1 small and 1 large
Postnasal packing setup
Tracheostomy setup
Petrolatum
Gauze sponges
Local set and anesthetics
Adrenalin solution 1:1,000

Sutures

Surgical gut, plain and chromic, Nos. 2-0 and 3-0
Silk Nos. 2-0 and 3-0
Murphy needle No. 2
Surgeon's needle, ⅜-circle, cutting-edge No. 8



Fig. 199.—Completed sterile draping with head drape fastened on both sides to sterile towel across chest. (From Winter, L.: Operative Oral Surgery, St Louis, The C. V. Mosby Co.)

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table in a supine or Rose position (Chapter 4). His face is cleansed with a mild antiseptic solution. His head is wrapped in a towel and held in place with a towel forceps; then a sheet is draped over him from below the chin downward over the feet. The upper portion of the face may be draped with two large gauze pads and held in place with towel forceps. (Fig. 199.)

Operative Procedure.—The major steps and items for a hemiglossectomy include the following:

For excision of wedge-shaped portion of the tongue: (1) The pharynx is packed and the tongue is retracted with a heavy silk transfixion suture. (2) A wedge-shaped portion of the tongue is removed with knife, scissors, and electrocautery. Radium may be implanted (Chapter 4). (3) The wound is closed with silk sutures

For excision of longitudinal half of tongue (Blair technique): (1) The mouth is held open with a mouth gag; transfixion sutures are placed in the tongue. (2) The tongue is split in midline back to the frenum; the halves are separated by blunt dissection. (3) The floor of the mouth is incised and the blood vessels ligated, the muscles divided, and half the tongue removed at its base. The traction suture on the preserved half of the tongue is left in place until the patient recovers from the anesthetic. A nasal catheter is inserted into the pharynx.

Removal of Salivary Calculus or Ranula

Definition.—Through an opening in the mucosal layer of the mouth, the duct is opened, and the calculi or cyst removed.

Setup.—The items include the following:

Instruments

1 Ether hook; mouth gag for general anesthetic
1 Tongue depressor
1 Throat suction tube
1 Antrum cannula
1 Suction rubber tubing, 36 inches
6 Mosquito hemostats
6 Kelly hemostats
3 Crile hemostats
2 Allis forceps
1 Scalpel with handle No. 3, blade No. 10
1 Tissue forceps with 1 and 2 teeth
1 Tissue forceps without teeth
1 Metzenbaum scissors, 7 inches
1 Mayo scissors
1 Needle holder
2 Curettes, small size
1 Probe
Narrow gauze packing
Electrosurgical unit, if desired

Textiles and Sutures

1 Minor throat pack
1 Glove set
1 Gown pack
2 Regular sheets for draping patient
12 Dental postage stamps or small sponges
12 Peanut sponges
6 Compresses, 3 by 3 inches
Postnasal setup
2 Silk sutures No. 3-0 swaged-on dental needles

Operative Procedure.—The patient is placed on the operating table in a supine position and draped with a sheet as for antrostomy. The mouth is held open with a mouth gag and the mucus removed with suctioning. An incision is

made in the mouth, and the cyst or calculi are dissected free from the submaxillary or sublingual duct.

Resection of Upper or Lower Jaw

Definition.—Resection of a portion of the involved upper or lower jaw.

Purpose.—Resection of upper or lower jaw is done to remove a lesion involving the upper jaw (maxilla), the lower jaw (mandible), the alveolar process, the lower border of the mandible, or the soft palate surrounding the upper jaw.[25, 28, 29, 41]

Anatomy.—The mandible is a strong prominent bone comprising the lower jaw (Fig. 200). It articulates by means of the temporomandibular joint and is held in position by muscles and ligaments which are attached to the cranium and to facial bones (Fig. 198).

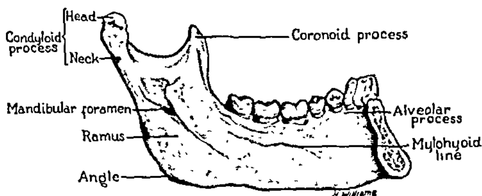


Fig 200—Medial surface of left of mandible. (From Francis, C. C, Knowlton, G. C, and Tuttle, W. W.: Textbook of Anatomy and Physiology, St. Louis, 1943, The C. V. Mosby Co)

The maxillary bones and the nasal and molar bones form the framework of the upper part of the face Each maxillary bone helps to form three cavities: the orbit, the nasal fossa, and the upper part of the oral cavity.[2, 3, 25, 26]

Setup.—As for partial glossectomy, plus the following:

Instruments

Tooth extraction instruments, if desired
2 Periosteal elevators, sharp and blunt, narrow width
1 Periosteal elevator, flat
1 Hand drill and drill points, or electric drill with drill points and saw blades, or nasal saws
4 Gigli saws, 12 and 20 inches
2 Gigli holders
1 Osteotome, 6 mm. in diameter
2 Chisels, with thin straight blade, ¼ and ½ inches wide
1 Mallet
2 Curettes, Nos. 3-0 and 0
1 Van Buren bone-holding forceps
1 Nasal scissors, heavy angular type
2 Rongeurs — 1 curved and flat; 1 curved sideways
Wiring setup for teeth, if desired
Radium setup, if needed

Precautionary Measures.—Because bleeding is often profuse, an adequate suction setup is needed, thereby preventing aspiration of blood and infected mucus. Infusion and blood transfusion setups and parenteral fluids should be available.

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table in a supine position, with his head and shoulders slightly elevated. If a reverse Trendelenburg position is to be used, a footpiece is attached to the table as described for thyroidectomy. The face is cleansed with a mild soap or detergent and painted with a germicide (Chapter 3).

A small sheet is placed beneath the head, which then is wrapped in a towel. The patient is covered with a large sheet, and towels are placed around the proposed operative site.

Operative Procedure.—The instruments and materials must be suitable for use in the involved area. In general, the steps and items include the following:

Steps	*Items*
1. The incision is usually made just below the mandible from the angle of the chin.	1. Packing may be inserted in the oral cavity; scalpel, tissue forceps, without teeth, gauze, suction, retractors
2. The superior alveolar process.	2. Dental instruments for removal of teeth
3. The soft tissues are divided down to the periosteum and separated from the bone.	3. Scalpel, tissue forceps, elevators, suction set
4. The buccal cavity is opened, exposing the alveolus.	4. Dissection instruments, retractors, Allis forceps
5. The mucosa and peritoseum are incised along proposed resection line.	5. Scalpel, tissue forceps, suction set, gauze sponges
6. A section of bone is removed.	6. Drill, electric saw, chisel or osteotome or Gigli saws; bone forceps
7. The bone edges are made smooth.	7. Raspatory forceps, rongeur
8. Bleeding is controlled.	8. Gauze packing, suture ligatures
9. The wound layers are closed.	9. Chromic gut No. 2-0 or silk No. 2-0, Mayo needle No. 5
10. The wound may be drained and packed, and dressings are applied.	10. Penrose drain, gauze packing, compresses and gauze bandages.

For Resection of the Mandible.—The incision is usually made below the mandible from below the lobe of the ear to the chin. Muscles are detached; parotid gland and tongue are retracted. The bone is freed from the joint and resected. Bleeding is controlled, and the wound is usually closed by sutures and partially packed.

Removal of Impacted Teeth

Definition.—Removal of teeth through the buccal aspect.

Considerations.—Indication for the removal of roots is dependent upon several factors: their location in the mandible or in the maxilla region, the

extent of the overlying bone, and the depth of the retained root. Because asepsis is essential to prevent infection, this procedure is usually performed in an operating room, and strict aseptic technique is followed.

Setup.—The items include the following:

Instruments

Dental instruments, including curettes, chisels, hammer, gouges, forceps, and electric drill with burrs
4 Kelly curved hemostats
4 Mosquito curved hemostats
4 Mosquito straight hemostats
2 Crile hemostats
2 Mayo-Pean hemostats
2 Scalpels, with handles No. 3, blades Nos. 11 and 15
2 Scissors, curved and straight, 5½ inches
1 Bayonet forceps
1 Tissue forceps, 1 and 2 teeth
1 Tissue forceps without teeth
4 Towel forceps
1 Needle holder, 6½ inches
2 Cheek retractors, blades
1 Tongue depressor
1 Side mouth gag
2 Throat suction tips with rubber tubing
1 Emesis basin
2 Medication glasses
Adrenalin solution 1:1,000
1 Large sheet for patient
1 Package postage stamps
1 Package compresses, 4 by 4 inches
1 Leg roller (3-inch folded plain packing)
1 Narrow piece of stockinet for drill handle
Petrolatum packing, narrow width
Iodoform packing, ½ inch wide
2 Dental sutures swaged-on needles

Also

Headlight
Skin cleansing preparation tray
Headrest
Dental x-ray pictures of patient

Position, Skin Preparation, and Draping Procedure.—As described for partial glossectomy.

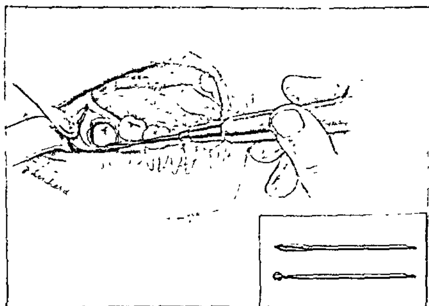


Fig. 201.—Mucoperiosteal incision made, flap laid back. With the use of a burr the overlying and buccal bone is removed and a wedge is created between the buccal aspect of the bone and the impacted third molar. (From Winter, L. Operative Oral Surgery, St. Louis, The C. V. Mosby Co.)

Operative Procedure.—

1. The pharynx is packed with gauze packing. An incision is usually made through the mucous membrane down to the bone.

2. A mucoperiosteal incision is made, and the tissue is raised from attachment of the bone and retracted (Fig. 201).

3. The overlying bone may be removed by surgical burr.

4. The tooth is removed, and the bleeding vessels are ligated. The wound is irrigated, and the mucosal flap is sutured back into place. A drain may be inserted.

Reduction of Fractured Jaw

Classification of Fractures of the Jaw.—(1) Fractures within the oral cavity, including the maxillary alveolar process. (2) Horizontal fractures below the orbits. (3) Horizontal fractures involving the orbit, molar, and nasal bones[25,26,45]

Fractures may be simple, compound, depressed, or impacted. The method of treatment will depend upon the type of fracture and its location (Figs. 202 to 204). In general, the basic setup includes the following:

Instruments

1 Scalpel with handle No. 3 and blade No. 15
2 Tissue forceps with teeth
1 Tissue forceps without teeth
1 Mayo scissors, curved
1 Suture scissors
2 Allis forceps
2 Crile hemostats
2 Kelly hemostats
4 Kocher forceps
2 Mayo-Pean hemotsats, curved
1 Needle holder, 7 inches
3 Towel forceps
1 Nasal dressing forceps
1 Antrum cannula and rubber suction tubing
1 Throat tube and rubber suction tubing
2 Volkman or Miller retractors
2 Cheek retractors
1 Mouth gag
1 Tongue depressor
1 Periosteal elevator, broad end
1 Periosteal elevator, small end
1 Probe
1 Curette
1 Electric or hand drill with three points, sizes 5, 6, and 7
1 Pair pincers, edges serrated
1 Pair pincers, short-contouring blades
1 Pair wire cutters
1 Wrench
1 Wire ligature carrier
Dental instruments for extraction
Pin or splint fixation appliance, if desired (Figs. 203 and 204)
Penrose drain
Plaster cast set, if desired
Asch forceps for nose
Clothespin for head lamp

Sutures

2 Murphy needles No. 3, trocar-point
2 Murphy needles No. 4, taper-point
1 Tonsil suture swaged-on needle
Stainless steel wire, desired sizes
Silk Nos. 4-0 and 3-0
Surgical gut, plain No. 2-0

Textiles

Minor throat pack
Postnasal packing setup
Gown pack
Glove set
Postage stamps
Compresses, 3 by 3 inches
Skin preparation setup
Submucous sponges
Dental rolls

Fig. 202—Arch wire splint with intermaxillary wires. (From Thoma, K. H.: Traumatic Surgery of the Jaws, St. Louis, 1942, The C. V. Mosby Co.)

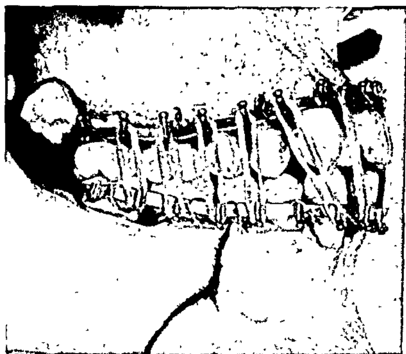


Fig. 203—The Winter fracture splints attached and elastic bands applied to the lugs. (From Thoma, K. H.: Traumatic Surgery of the Jaws, St. Louis, 1942, The C. V. Mosby Co.)

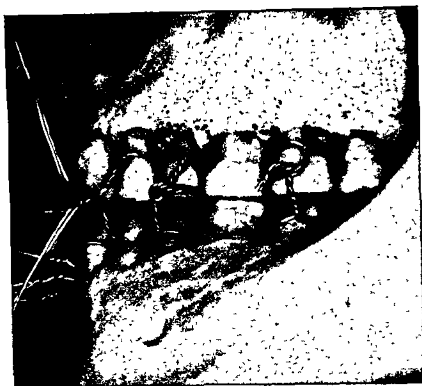


Fig. 204.—Intermaxillary ligation in premolar and molar region. (From Thoma, K. H.: Traumatic Surgery of the Jaws, St. Louis, 1942, The C. V. Mosby Co.)

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table in a supine position. His face is cleansed with a detergent and germicide. Aseptic techniques are followed. The patient is draped with sterile sheets

Operative Procedure.—The type and location of the fracture will determine the procedure. Stainless steel wire and elastic bands may be used to treat fractures of the alveolar process (Figs. 202 to 204). For fractures of the edentulous portion of the jaw, wires may be introduced through drill holes; or the wire may be placed in circumferential fashion around the fractured fragments. Intraoral fixation with splints or pins may be used. Extraoral fixation may be accomplished with a skeletal appliance.

In treating fractures of the maxilla below the orbits a wiring method is usually performed, and frontal and ethmoid sinuses may be examined, the foreign bodies removed, and lacerations of the face sutured. External dressing of the Barton type may be applied (Figs. 205 to 208).

Fractures of the zygomatic process or the body of the molar bone (cheekbone) are frequently treated by external fixation. A nick is made in the skin, and a bone hook is introduced and passed beneath the fractured bone to bring it into correct position.

Fractures posterior to the dental arch are treated by extraoral fixation by means of pins or screws which will permit the patient to use the mandible. Skeletal fixation with a Roger-Anderson or similar appliance may be used.

Fractures of the mandible within the dental arch are reduced and the jaw immobilized by application of wires.



Fig 205.

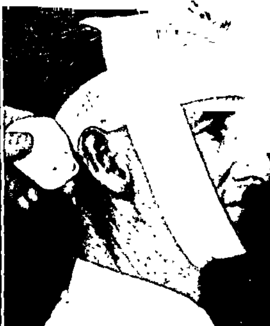


Fig 206.

Figs. 205 and 206—Application of Barton bandage, first and second turns (From Thoma, K. H.: Traumatic Surgery of the Jaws, St. Louis, 1942, The C. V. Mosby Co)



Fig 207.

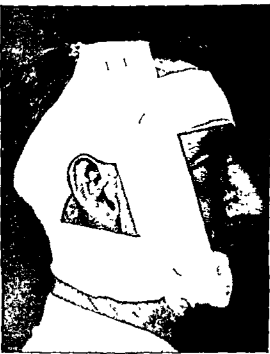


Fig. 208

Figs 207 and 208—Application of Barton bandage, chin turn and stapling. (From Thoma, K. H.: Traumatic Surgery of the Jaws, St Louis, 1912, The C V. Mosby Co)

Fractures of the upper and lower jaw, including the nasal bones, or displacement of the ramus may be reduced by application of a plaster skull cap and external fixation by means of pins or application of a Barton bandage.

REFERENCES

1. Shackelford, R. T.: Bickham-Callander Surgery of the Alimentary Tract, Philadelphia, 1955, W. B. Saunders Co., chap. 13.
2. Williams, R. G. Anatomy of the Mouth and Pharynx, vol. 4, chap. 1; Anatomy of the Neck, Larynx, Lower Respiratory Tract and Esophagus, vol. 4, chap. 19; in Otolaryngology, Hagerstown, Md., 1955, W. F. Prior Co.
3. Truex, R. C., and Kellner, C. E: Detailed Atlas of the Head and Neck, New York, 1948, Oxford University Press.
4. Francis, C. C: Introduction to Human Anatomy, St. Louis, 1954, The C. V. Mosby Co
5. Lederer, F. L.: Diseases of the Ear, Nose and Throat, ed 6, Philadelphia, 1952, F. A. Davis Co
6. Manhattan Eye, Ear and Throat Hospital. Nursing in Diseases of the Eye, Ear, Nose and Throat, ed 9, Philadelphia, 1952, W. B Saunders Co.
7. McDowell, F: Plastic Surgery of the Nose, St. Louis, 1951, The C. V. Mosby Co
8. Hollender, A. R, and others: The Pharynx: Basic Aspects and Clinical Problems, Chicago, 1953, Year Book Publishers, Inc.
9. Ciba Foundation: The Ciba Collection of Medical Illustrations of Neck, Boston, 1953, Little, Brown & Co.
10. Brown, J. B: Plastic Surgery of Nose, St Louis, 1951, The C V. Mosby Co.
11. Murphy, D L, and others: Fractures Facial Injuries, GP 47:52, 1952
12. Ochsner, A., and DeBakey, M. E: Christoper's Minor Surgery, ed. 7, Philadelphia, 1955, W. B. Saunders Co, chaps 13, 21.
13. Moseley, H. F.: Textbook of Surgery, ed. 2, St. Louis, 1955, The C V Mosby Co.
14. Parkinson, R. H: Tonsil and Allied Problems, New York, 1951, The Macmillan Co
15. Kernan J., and others: Surgery of Nose and Throat, New York, 1942, Thomas Nelson & Sons, Inc.
16. Hill, F. T: Infections of the Lymphoid Tissue, Tonsillectomy and Adenoidectomy in Otolaryngology, Hagerstown, Md, 1955, W F Prior Co, vol 4, chap 7
17. Hall, J S: Diseases of the Nose, Throat and Ear, ed 5, Baltimore, 1952, Williams & Wilkins Co.
18. Brighton, G F: Surgery of the Oropharynx and Nasopharynx, in Kernan: Surgery of the Nose and Throat, New York, 1942, Thomas Nelson & Sons, chap. 3.
19. Blair, V. P: Essentials of Oral Surgery, ed. 4, St. Louis, 1953, The C V. Mosby Co.
20. Boies, L. R: Fundamentals of Otolaryngology, Philadelphia, 1949, W. B Saunders Co
21. Brown, J. B, and McDonnell, F: Neck Dissections, Springfield, Ill, 1954, Charles C Thomas, Publisher.
22. Pressman J. J.: The Physiologic Mechanism and Functions of the Larynx in Otolaryngology, edited by Coates, G M, and others, Hagerstown, Md, 1955, W. F. Prior Co, vol. 4, chap. 20.
23. Jackson, C, and Jackson, C L: Surgery of the Larynx and Trachea and Endoscopic Surgery of the Bronchi; in Lewis' Practice of Surgery, Hagerstown, 1955, W. F. Prior Co, vol IV, chap 7.
24. Richards, V: Surgery for General Practice, St. Louis, 1956, The C V. Mosby Co
25. Rowe, W L, and Kelley, H. C: Fractures of the Facial Skeleton, Edinburgh, 1955, E. & S. Livingstone, Ltd.
26. Stark, R. B and Henderson, L. M: Facial Injuries—Surgical Treatment and Nursing Care of the Patient, Am J Nursing 57:450, April, 1957.
27. Foman, S: Otolaryngologic Plastic Surgery in Otolaryngology, Hagerstown, Md, 1955, W. F. Prior Co, vol. 3, chap 26
28. Bowers, W F: Surgery of Trauma, Philadelphia, 1953, J B. Lippincott Co.

29. Pulaski, E: Surgical Infections, Springfield, Ill, 1954, Charles C Thomas, Publisher.
30. Calcock, B P: Surgery of Adenomatous Goiter, S. Clin. North America 6:60, 1956.
31. Crile, G. B.: Practical Aspects of Thyroid Disease, Philadelphia, 1950, W. B. Saunders Co.
32. Carroll, W.: The Neck, in Christopher, F.: Textbook of Surgery, ed. 6, Philadelphia, 1956, W. B Saunders Co, chap. 12.
33. Ariel, I.: Treatment of Tumors of the Parotid Salivary Gland, GP 13:92, April, 1956
34. Maresca, R. L and Okino, S. Y: The Size of Tracheotomy Tubes: Its Effect on Ventilation of Respiratory Patients With Poliomyelitis, Ann. Otol. Rhin. & Laryng. 55:674, 1956.
35. Atkins, J. P.: A Tracheotomy Tube for Maximal Pulmonary Ventilation, Am J. Obst. & Gynec. 65.1080, 1956.
36. Arhelger, S W: The Advantages of Tracheotomy and Use of a New Tracheal Tube in Management of Intratracheal Aspiration, Surgery 29:260, 1956.
37. Carter, B. M, and Guiseffi, J.: The Use of Tracheotomy With Treatment of Crushing Wounds of the Chest, J. Thoracic Surg. 96:55, 1953.
38. Holinger, P. H, and others. Tracheotomy, S Clin North America 2:21, 1955.
39. Emerson, E B, Jr.: A Safe and Positive Method of Tracheobronchial Aspiration in the Newborn, J A.M A. 144:633, 1950.
40. Conley, J: Tracheotomy, Am. J Nursing 52:1078, Sept., 1952
41. Carroll, V. W.: Combined Neck and Jaw Resection for Intraoral Carcinoma, Surg. Gynec & Obst. 94:1, 1952
42. Stevenson, R. S: Recent Advances in Oto-laryngology, New York, 1949, McGraw-Hill Book Co, Inc.
43. Hoover, W. B: The Technique for "Wide Field" Total Laryngectomy, S. Clin North America 6:589, 1956.
44. Martin H., and Ehrlich, H E: Neck Dissection, Cancer 4:441, 1951.
45. Thoma, K H.: Traumatic Surgery of the Jaws, St Louis, 1942, The C. V. Mosby Co.

*Films**

Brown J, and McDowell, C.; Correction of Nasal Deformities.
Baumgartner, C. J; Surgical Anatomy of Neck and Thyroid Gland.
Brown, J B, Complete Neck Dissection
The Lahey Clinic: Thyroidectomy

*Films may be obtained from the Surgical Products Division, Inc, American Cyanamid Co, Danbury, Conn.

CHAPTER 8

ENDOSCOPY PROCEDURES

OPERATING ROOM FACILITIES AND EQUIPMENT

The kind and number of instruments and amount of operating room space that will be needed to care for patients requiring endoscopic procedures depend on the scope and type of medical conditions treated in the hospital. However, each hospital should be equipped to carry out emergency endoscopy procedures.[1-3]

The Operating Room Unit

The room should be of modern design, including explosive-proof flooring, electric outlets, cords, and x-ray viewer (Chapter 1). Adequate light-proofing is necessary since the endoscopist needs darkness to help blot out the images in the eye when he is not looking into the endoscope. During the procedure light should come from behind the operator so that it is not reflected on the inner surface of his glasses. The color of the room and the sterile sheets should rest the operator's eyes and increase his power of perception. (Chapter 1.)

An endoscopy room should be large enough to permit the proper arrangement of tables and other equipment so that the operating team can care for the patient quickly and effectively (Chapter 4). Furniture, built-in equipment, and color are discussed in Chapter 1. An endoscopy table (Jackson model) makes it easier for the surgeon to treat the patient and safeguards him from injury. The assistant will need a footrest which should be protected with explosive-proof rubber guards and should measure 10 by 12 by 14 inches, thereby providing three different heights. The assistant operator can position the footrest so that it suits his height and is 25 inches away from the top of the operating table. The operator needs an adjustable metal stool with nonskid explosive-proof cushions on its feet.[4]

Instruments for Bronchoesophagoscopy Operations

A mobile bronchoscopic unit is required when many procedures are frequently carried out. Two instrument tables, a topical anesthesia tray on casters, a reflecting lamp, and a flushing apparatus, which is installed over the sink in the substerilizing unit, are necessary. The kind, size, and number of instruments will depend on the needs of the patients who are admitted to the hospital.

The laryngoscope is a hollow tube with a light carrier and lamp. It is used for the introduction of the bronchoscope or esophagoscope. Laryngoscopes are made in various sizes and lengths suitable for adults, children, and newborn infants. (Figs. 209 and 210.) Frequently a bronchoscope 7 mm. lumen is used with

Fig. 209 — Instruments for diagnostic laryngoscopy. From above downward: anterior commissure laryngoscope (C.L.J. model); tissue forceps (laryngeal grasping forceps should be included, similar to tissue forceps but with straight alligator jaws); aspirating tube, metallic, aspirating tube, silk-woven; laryngeal syringe (Lukens model); sponge carrier for secure holding of gauze sponges for swabbing, hemostasis, and obtaining smear specimens; mouth opener (C.L.J. model); bite block, suitable size. (From Jackson, C, and Jackson, C. L.: Bronchoesophagology, Philadelphia, 1950, W B. Saunders Co)

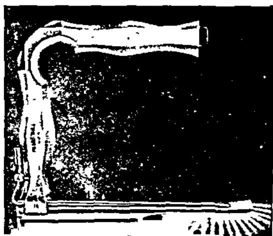


Fig 210 — Laryngoscope for introduction of a bronchoscope. The slide permits the removal of this necessarily rather heavy displacing instrument in the trachea for safe exploration of the tracheobronchial tree and for passage of the bronchoscope (From Jackson, C, and Jackson, C. L: Bronchoesophagology, Philadelphia, 1950, W. B Saunders Co)

the adolescent-sized laryngoscope. The chief characteristics of the laryngoscope include a strong horizontal handle, which keeps the muscular tongue under control, and a slide blade, which can be withdrawn so that the laryngoscope can be removed without disturbing the bronchoscope that has been inserted. An anterior commissure laryngoscope is needed to explore the trachea and larynx and in the removal of certain growths.[1,2]

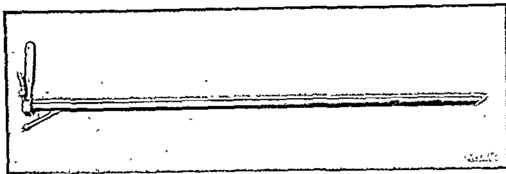


Fig 211.—Bronchoscope made of thin metal, light and delicate, for exploration of the tracheobronchial tree. It can be introduced with or without the laryngoscope. The slightly oblique illumination gives remarkable definition impossible to obtain with the axial beam of the proximal lighting. The branch inlet is used for attachment of the rubber tube from the wash bottle of the oxygen tank for continuous insufflation of oxygen when needed during endoscopic procedures or transthoracic operations. (From Jackson, C, and Jackson, C. L: Bronchoesophagology, Philadelphia, 1950, W. B. Saunders Co)

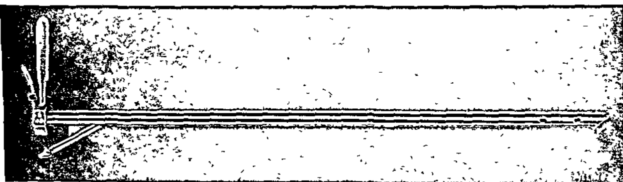


Fig. 212.—Aspirating bronchoscope. The canal in the wall of the tube maintains a clear field by the continuous aspiration of pus, blood, or other fluid without a moment's delay. Invaluable in such conditions as bronchiectasis, pulmonary abscess, drowned lung, and prolonged sojourn of foreign body. This instrument is particularly useful in adults, adolescents, and older children. (From Jackson, C, and Jackson, C. L: Bronchoesophagology, Philadelphia, 1950, W. B. Saunders Co)

The standard bronchoscope is used to explore the bronchial tree. It consists of a hollow, metal tube with a slanting tip, slightly bevelled, and incorporated within it is a light carrier with a lamp to provide distal illuminaton at an oblique angle to the area in the body which is being examined. There are openings along the side of the lower portion of the scope so that when it is inserted into one lung, the other lung can breathe through the scope's openings (Fig. 211.) The opening on the side arm, situated at its proximal end, is used to administer oxygen.[2,5]

The aspirating bronchoscope has a separate channel running the full length of the tube to permit constant aspiration of secretions during the examination

(Fig. 212). Other types of bronchoscopes are designed for specific purposes. They include the expanding staple bronchoscope, the costophrenic scope, the catheterizing scope, and the optical telescope which are passed through a standard bronchoscope.[1,2,5-8] The bronchoscopes commonly used are as follows: for adults, two standard Jackson models, 7 mm. lumen, 40 cm. long, or a Broyles' model with telescope, and one standard aspirating scope, 7 mm. lumen, 40 cm. long, for adolescents, one standard Jackson model, 4 mm. lumen, 30 cm. long, one standard model, 5 mm. lumen, 30 cm. long; for children, one standard Jackson model, 4 mm. lumen, 30 cm. long; for infants, one standard Jackson model, 3 mm. lumen, 30 cm. long, or 3.5 mm. lumen, 30 cm. long.

The esophagoscope is used to examine the cardiac antrum of the stomach, the cervical esophagus, or the pylorus and duodenum.[1,6] Bougies and forceps can be passed through the scope's lumen. Esophagoscopes are either rigid or flexible. The standard type consists of a hollow metal tube, which has a slanting bevelled tip. Its oval-shaped lumen opens at its distal end and has three channels, one for the light carrier and lamp, a second for the passage of secretions, and a third for visualization. On the side arm of the aspirating channel there is a thumb valve which permits the operator to control the suction. A constant suction, even when it is very weak, may suck in the esophageal mucosa so that it obstructs the free passage of the instrument and the operator's view.

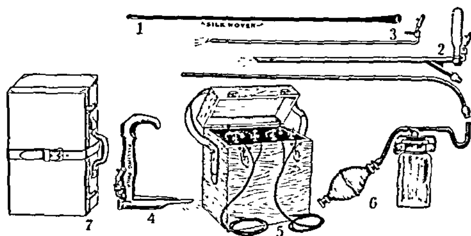


Fig 213—Instruments for clearing the airway of the newborn infant: *1*, Silk-woven aspiration-insufflation tube, *2*, bronchoscope, infant size; *3*, extra light carrier; *4*, laryngoscope, infant size, *5*, two circuit battery and cords, *6*, aspirator, *7*, carrying case. (From Jackson, C, and Jackson, C. L: Bronchoesophagology, Philadelphia, 1950, W. B. Saunders Co)

The size of the instrument to be passed through an esophagoscope is determined by its lumen, multiplied by three. For example, if a scope has a 3 mm. lumen, a bougie or instrument, size 24 F, can be passed through it. Esophagoscopes and forceps are commonly used as follows: for examining tall, long-waisted adults, a scope with a 7 mm. lumen and 45 cm. long, and a forceps not less than 50 cm. in length, or for examining the cardia of the stomach in adults, a scope with a 9 mm. lumen and 53 cm long, and a forceps 60 cm. long. For examination or dilatation of the cervical esophagus, or for removal of a foreign

body in this region, a scope with a 9 mm. lumen and 30 cm. long, and a forceps 50 or 40 cm. long are used. A Tucker esophagoscope with an 8 mm. lumen and 58 cm. long may be used to examine the stomach and duodenum.[6]

For children between the ages of 5 and 14, a scope with a 7 mm. lumen and 45 cm. long, and forceps 40 or 50 cm. long are used; for children between 2 and 5, a scope with a 6 or 5 mm. lumen and 35 cm. long, and forceps 35 cm. long; for newborn infants, a scope with a 5 mm. lumen and 35 cm. long (Jackson model), or one with a 3½ mm. lumen and 30 cm. long (Hollinger-Jackson model), and forceps 35 cm. long.

The flexible gastroscope is also used to examine the stomach.[9, 10] The Schindler model consists of a closed tube 78 cm. long. At the lower end of the scope there is a lamp enclosed in a rubber piece; its flexible portion contains electric wires, and its upper rigid portion, which contains the lenses, acts as a passageway for the air and electric wires. The eyepiece, which contains some optical elements, has side arms for connecting the electric cords and the air balloon

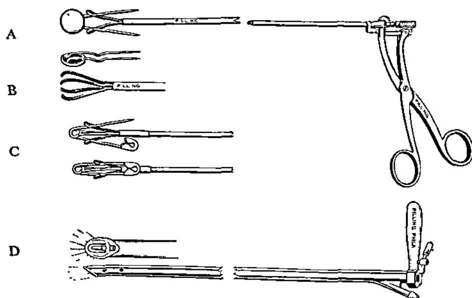


Fig 214—Instruments used in foreign body removal: *A*, Chevalier Jackson approximation forceps; *B*, Gordon bead forceps; *C*, Clerf safety-pin closer; *D*, Jackson-Manges roller bronchoscope and esophagoscope. (From Jackson, C., and Jackson, C. L.: Bronchoesophagology, Philadelphia, 1950, W. B. Saunders Co)

Lamps, Lamp Carriers, Cord of Endoscopes, and Battery Box.—Each scope requires a light carrier and lamp and cord. Duplicates of each piece should be available during surgery.

The battery box, consisting of nine dry cells which are arranged in groups of three to provide a triple circuit, should be tested at frequent intervals by the engineer. A commercial circuit must not be used since it may cause the patient to be electrocuted when the moistened scope is close to the thoracic nerves.

Sponge Carriers and Sponges.—The carrier consists of two metal parts, an inner rod, which has two jaws protruding from its distal end, and an outer band,

which can be screwed down upon the inner rod so that the protruding jaws hold the gauze sponges. (Figs. 209 and 217.) The gauze sponge must be firmly attached to the sponge carrier, because a lost sponge in the bronchi may be difficult to locate. Sponges are needed to keep the field dry, remove secretions, or apply topical anesthetics. Each bronchoscopy setup requires three or four carriers and sponges of a size that will pass through the scope.

Aspirating Tubes.—These tubes of different lengths and design are used to remove tracheobronchial secretions of patients with postoperative bronchiectasis or certain bronchial lesions.[3,11-14] The straight rigid type is used to remove material from the pharynx, the larynx, and the esophagus. (Figs. 214 and 215.) Its distal end has one or two openings in which the edges are rounded and depressed to protect the mucosa if it should be drawn through the openings due to an existing negative pressure. The curved aspirating tube with a flexible spring-coiled tip is used to aspirate material from the upper and dorsal orifices of the bronchi. Each clinic should have several aspirating tubes in sizes to correspond to the lumen and length of the endoscopes.

Specimen Collectors.—*Each clinic setup requires a minimum of three cytologic Clerf collectors and three Lukens collectors.*

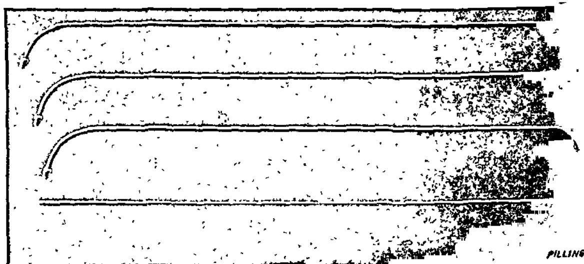


Fig 215.—Aspirating tubes for use through the bronchoscope Tubes with curved and flexible ends are useful for obtaining cytologic specimens from upper lobe bronchi, but routinely the tussive squeeze forces secretions and exudates into the larger bronchial stems within reach by means of straight tubes Below is a sponge carrier for carrying gauze sponges. It holds gauze sponges secure against loss in the bronchi when used for swabbing, hemostasis, or obtaining smear specimens It is used similarly through the esophagoscope (From Jackson, C. and Jackson, C L: Bronchoesophagology, Philadelphia, 1950, W B Saunders Co)

Fig 216.—Forceps for bronchoscopy 1, Forward-grasping forceps with serrated and slightly cupped jaws, used for all ordinary purposes, 2, side-curved forceps, also used for general purposes—the jaws are thin and flat, 3, ball (cupped) forceps for taking specimens of tissue; 4, rotation forceps for holding securely while affording pivotal contact for changing a malpresentation to a favorable presentation, 5, ring-rotation model that holds securely while permitting certain kinds of foreign bodies to dangle, 6, head-holding forceps (C.L.J. model) for grasping head or shank of screws, nails, and tacks—also affords pivotal contact Special forms of forceps are required for special purposes (From Jackson, C, and Jackson, C L: Bronchoesophagology, Philadelphia, 1950, W B Saunders Co)

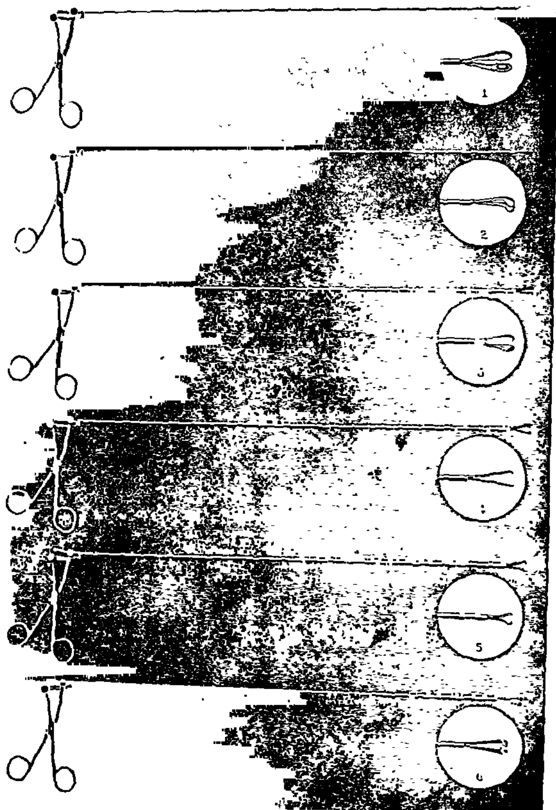


Fig 216—*For legend, see opposite page*

which can be screwed down upon the inner rod so that the protruding jaws hold the gauze sponges. (Figs. 209 and 217.) The gauze sponge must be firmly attached to the sponge carrier, because a lost sponge in the bronchi may be difficult to locate. Sponges are needed to keep the field dry, remove secretions, or apply topical anesthetics. Each bronchoscopy setup requires three or four carriers and sponges of a size that will pass through the scope.

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Specimen Collectors.—Each clinic setup requires a minimum of three cytologic Clerf collectors and three Lukens collectors.

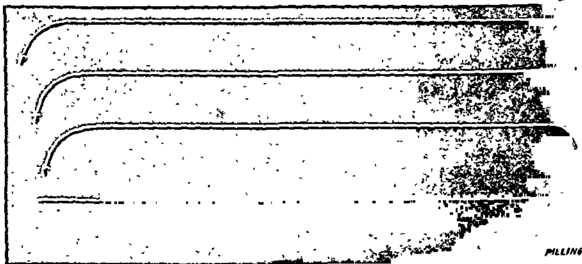


Fig 215 —Aspirating tubes for use through the bronchoscope. Tubes with curved and flexible ends are useful for obtaining cytologic specimens from upper lobe bronchi, but routinely the tussive squeeze forces secretions and exudates into the larger bronchial stems within reach by means of straight tubes Below is a sponge … It holds gauze sponges secure against loss in the bronchi wl… or obtaining smear specimens It is used similarly through … C, and Jackson, C L · Bronchoesophagology, Philadelphia, 1950, W B Saunders Co)

Fig 216 —Forceps for bronchoscopy: *1*, Forward grasping forceps with serrated and slightly cupped jaws, used for all ordinary purposes; *2*, side-curved forceps, also used for general purposes—the jaws are thin and flat, *3*, ball (cupped) forceps for taking specimens of tissue; *4*, rotation forceps for holding securely while affording pivotal contact for changing a malpresentation to a favorable presentation; *5*, ring-rotation model that holds securely while permitting certain kinds of foreign bodies to dangle, *6*, head holding forceps (C L.J model) for grasping head or shank of screws, nails, and tacks—also affords pivotal contact Special forms of forceps are required for special purposes (From Jackson, C. and Jackson, C L. Bronchoesophagology, Philadelphia, 1950, W. B Saunders Co)

For Light Carriers With Lamps and Telescopes.—Wash and immerse the equipment for 5 minutes in a nonionizing disinfectant (Chapter 2). After disinfection is completed, remove the lamps from the carriers, clean the threads of the lamps and the contact in the carriers (using an Imperatori or a pin); then insert the lamp into the carrier, attach the cord to the carrier and battery, and test the lighting system. Insert the proper light carrier and lamp into the endoscope, and place the damaged parts in the repair box.

For Electrodes, Cords, Silk-Woven Bougies.—Sterilize by autoclaving those bougies and cords that can withstand moist heat; or flush and immerse others in a good detergent. Rinse in cold tap water and dry, keeping bougies and electrodes straight, and wiping cords gently to prevent breaking the wire coils. Then test and store them.

For Forceps.—Chemically prepare all soiled forceps, using a washer-instrument sterilizer or ultrasonic cleaner. If a boiling-water sterilizer is used, boil the forceps for 45 minutes in a 2 per cent solution of trisodium phosphate.

After preparation is completed, take each forceps apart one at a time because their parts are not interchangeable.[15] Dissemble a cannulated forceps by unscrewing the nut and removing the stilette; then flush the cannula, wash the stilette, and rub off its rough places with a fine piece of emery cloth. Keep similar parts of the forceps together. Remove the spring bracket from the noncannulated forceps by slipping a dull-edged blade or Powers separator through the spring (bracket).

Dry the cannula and stilette of each forceps by starting with the handle and finishing at the distal end of the forceps in order to prevent catching the forceps' blades and straining them. Place a drop of noncorrosive solvent in the crotch of the forceps; replace the cannula by setting the screws and nuts correctly. Store the forceps with their jaws and blades open. Dry the parts of the noncannulated forceps, place a few drops of noncorrosive solvent between their sliding shafts and the movable parts of the jaws, replace the bracket, and store the forceps in the cabinet with jaws open

When inspecting and adjusting a forceps, observe that (1) jaws are close together in parallel position, (2) handles just touch when the jaws are closed, (3) the jaws go into the cannula when the forceps is closed and protrude widely without expanding the spring when it is open, (4) the end nut, which is located in the stilette, is in place, (5) the side screw is made as tight as possible by manual manipulation, (6) the distal end and jaws' edges are smooth upon finger examination.

For Aspirating Tubes and Other Tubular Parts.—Flush the aspirating tubes and scopes, using a pressure flushing apparatus (the Holman apparatus) to remove encrusted secretions Chemically clean by placing in a washer-instrument sterilizer of sufficient size, or use an ultrasonic cleaner, if available. Sterilize by autoclaving

After cleaning in a washer-instrument sterilizer flush each part thoroughly with water; clean the channels, using a worsted curved cleaner (Pilling) and a long-handled bristle brush; then, for a second time, flush all channels thoroughly.

Forceps.—Different types of forceps are designed for specific purposes (Figs. 214, 216, and 217). Their construction and size are suited for use in various regions and for the endoscope through which they will be introduced.

The laryngeal forceps most often used measure 20 and 28 cm. in length and are of several types: upward grasping, rotation, forward-biting cup, angular cup, basket biopsy (open-tip), basket biopsy (cupped-tip), and anterior commissure. A bronchoesophageal forceps consists of a stilette, cannula with a handle and screw, a lock nut, and a set screw. The handling of these forceps is discussed later in this chapter.

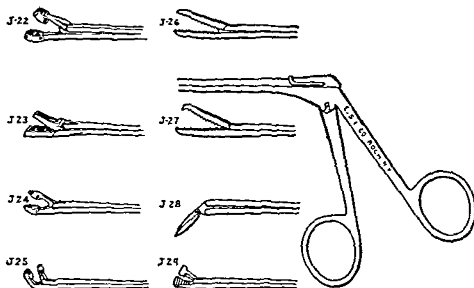


Fig 217.—Noncannulated forceps for laryngeal and bronchial regions: *J-22,* punch forceps for tissue specimens; *J-23,* laryngeal specimen and tissue forceps, *J-24,* straight cup-bite forceps, *J-25,* angular cut-bite forceps; *J-26,* straight alligator jaw-grasping forceps; *J-27,* rotation-alligator grasping forceps, *J-28,* laryngeal straight blade scissors, *J-29,* papilloma forceps for removal of recurrent laryngeal papillomas without injury to the vocal cords or delicate tissues (Courtesy Edward Weck & Co, Inc, Brooklyn, N. Y)

The forward-grasping forceps with slightly cupped and serrated jaws and the side-curved forceps with thin flat jaws can serve for all routine procedures. They are 50 and 60 cm. long and can be passed through an endoscope's visualizing channel. Other types are designed to remove specific kinds of foreign bodies or tissue situated in a definite bronchus or lobe.

The bite block prevents the patient from biting the metal endoscope and allows the surgeon to pass the tube more readily.

TERMINAL DISINFECTION AND CARE OF ENDOSCOPIC INSTRUMENTS

After each use, a member of the nursing team cleans, disinfects or sterilizes, tests, and stores the instruments (Chapter 2) By following this procedure the instruments are ready for future use. The method followed must destroy and remove all disease-producing bacteria, dirt, tissue, and encrusted secretions without damaging the construction and efficiency of the instruments.[1,15]

help himself during the operation, that if he breathes deeply, quietly, and regularly, and refrains from drawing himself up rigidly, the examination will be done more quickly and with less discomfort. Above all, she should reassure him that he will be able to breathe during the operation.

The patient is placed on an adjustable stretcher in a sitting position so that the operator can anesthetize the throat and larynx. The patient's tongue is depressed with a tongue depressor and the throat is sprayed with cocaine solution. The laryngeal mirror is warmed to prevent fogging and placed in the throat to expose the larynx. The circulating nurse turns on the lamp and adjusts it near the side of the patient. After the larynx has been anesthetized, the patient is placed in a supine position.



Fig 218—Position in which the patient must be held for satisfactory direct laryngoscopy (From Jackson, C, and Jackson, C. L: Bronchoesophagology, Philadelphia, 1950, W. B. Saunders Co)

Positioning the Patient, Skin Preparation, and Draping Procedure

The patient is generally placed in a supine position on a table with a sliding top (Fig 218). The patient's face is cleansed with a 50 per cent solution of alcohol; his head is wrapped in a towel, and his body is covered with a sterile sheet. The patient's head extends over the table and is slightly elevated, about eight inches from the level of the table.[3,6] The patient's head may be held by

Apply a nonirritating solvent to the inside of the tubular instruments to remove adherent mucus or grease; rinse them. Dry the inner surfaces of the endoscope by drawing gauze through its channels with the aid of a gauze carrier; clean channels with cleansing powder, if necessary.

Wipe aspirating tubes with gauze, starting at the proximal end and drawing the gauze lightly over the straight or spiral distal portion. If instruments are chemically cleaned in an ultrasonic cleaner, all baked blood, secretions, and tissue are removed.

A gastroscope is rinsed under warm running water while air is kept flowing through the inflation system. To do this, hold the instrument in a vertical position. Wipe the instrument with gauze sponges saturated with 95 per cent alcohol, and allow instrument to dry. Flow air through the air channel, using the bulb. Before using, rinse the scope in sterile distilled warm water and wipe off with a 95 per cent solution of alcohol.

Preparation of Instruments Prior to Use

When clean instruments are disinfected in a chemical other than alcohol, they are rinsed in cold sterile distilled water and dried with a sterile towel or gauze sponge; then their parts are assembled. The worker inspects and arranges the instruments on the sterile table according to the plan approved by the surgeon.

SETUP FOR TOPICAL ANESTHESIA

The setup for topical anesthesia is assembled on a small table and contains the following items:

1 Head mirror and light
3 Laryngeal mirrors, size 4 or 5
Tongue depressors
Paper compressed sponges or facial tissues
Emesis basin
Cotton
1 Basin with sterile water
1 Basin with alcohol, 95 per cent
1 Bottle and spray, cocaine solution, 4 per cent
1 Bottle and spray, cocaine solution, 10 per cent
1 Bottle and spray, pontocaine solution, 2 per cent
3 Medicine glasses, labeled for use of topical drugs
1 Lukens springe, with tips
1 Jackson cross-action forceps or 1 Schindler-type forceps
1 Alcohol lamp, and matches
1 Sodium Pentothal set, oxygen, and face mask for emergency use

PREPARATION OF THE PATIENT IN THE OPERATING UNIT

Admission of the Patient

The circulating nurse greets the patient and identifies herself, then turns off the ceiling lights, and turns on the silent sign. She is usually responsible for checking the patient's chart, making sure that the preoperative preparation has been carried out, that the patient's dentures have been removed, and that he has not eaten during the last six hours (Chapter 4).

The circulating nurse reassures him and explains in a gentle, positive manner the things he is expected to do. She should tell the patient how he can

During an esophagoscopy procedure the patient may have an attack of asphyxia, due to tracheal compression caused by pressure of a foreign body, a lesion, or an instrument, or due to a faulty position. An insufflation tube or a bronchoscope is passed immediately, and oxygen is administered through it.

When a pneumothorax occurs due to penetration of the pleura, it may be necessary to do an emergency thoracotomy (Chapter 9).

Bronchoesophagologic operations must be done following aseptic standards as for general surgery.[12] Although the patient may be immune to the bacteria that he harbors, an unsterile article may introduce other organisms which may prove virulent to him. The transference of syphilis, tuberculosis, diphtheria, and other diseases from one patient to another may occur if medical and surgical asepsis is not carried out.

The degree of efficiency of the operating team may mean the difference between life and death for the patient who is suffering from asphyxia, or it may mean an unsatisfactory, agonizing operation for the patient who has an elective operation. Inadequate care usually is due to the improper use of techniques, lack of knowledge and a step-by-step description of the nursing duties to be carried out in caring for the patients.

The operation must be carried out with precision and in an atmosphere of cooperation and quietness.[1] The team must be ready for the patient when he arrives. His fears will be further increased and his confidence lessened if he enters a room where doctors and nurses are rushing about. The team should always endeavor to keep the patient in a tranquil emotional state. The suction pump and wall suction apparatus must be operating smoothly before the patient is brought into the room. Extra light carriers, lamps, cords, and aspirating tubes must be sterile and ready for immediate use.

The bottles containing the specimens should be labeled correctly, the laboratory form filled in, and the specimen stored in the proper solution (Chapter 4). Cultures, slides, and tissue specimens should be sent to the laboratory immediately.

OPERATIONS

Laryngoscopy

Definition.—Direct visual examination of the interior of the larynx by means of an electric-lighted speculum, known as a laryngoscope (Figs. 209 and 210).

Purposes.—To obtain a specimen of tissue or secretion for pathologic examination, to instill a drug, or to introduce a bronchoscope.[2, 18]

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described previously for endoscopy procedures. The position of the operating team is shown in Fig. 218. Instrument setup includes the following:

Local Set
1 Bite block
1 Mouth opener, if desired
1 Anterior commissure laryngoscope and attachments suitable for infant, child, or adult (Fig. 209)
2 Aspirating metallic tubes (Fig. 209)
1 Aspirating tube, silk-woven, with connecting tip
1 Light carrier, extra bulb

the assistant operator or may be supported by a Robert headrest. The patient's forearms and hands, with palms downward, are secured at the sides, using the flaps of the muslin restraint sheet (Chapter 4). The assistant flexes the patient's head onto his chest to provide the desired extension. To provide a correct position so that the scope can be passed quickly and safely, the assistant rests his left foot on the footrest, keeps his right foot on the floor, rests his left elbow on his left knee, passes his right arm under the patient's neck, and holds the bite block with his right hand. The patient's shoulders rest against the table.

NURSING DUTIES DURING BRONCHOESOPHAGOLOGIC OPERATIONS

Because the surgeon must keep his eye focused on the endoscope and since time is an important factor, the scrubbed nurse stands at his right side and places the instrument in his hand so that he can grasp it in correct position ready for use. When the nurse hands a bronchoscope or esophagoscope to the operator, she holds it in her right hand, turns the scope's handle to the right, and then places the proximal part of the tube in the operator's hand.[2] She may move to the operator's left side to receive the laryngoscope and its slide.

The nurse places the aspirator in the operator's hand in such a way that he can grasp the tube near its proximal or curved end. He holds it in a pencil fashion, while the nurse directs its distal end toward the lumen of the scope's channel. (Fig. 219.)

When a forceps is used the nurse holds it in the fingers of her right hand near its distal end, and places it in the operator's right hand so that he can grasp the shank near its middle; the nurse then directs its distal end toward the lumen of the endoscope.

At the completion of the operation the circulating nurse makes the patient as comfortable as possible, endeavors to reassure him, and records the necessary data on the operative sheet The scrubbed nurse takes the soiled instruments to the utility room, removes her soiled gown and gloves, and dons others. She then removes the sterile instruments from the sterilizer, if necessary, and arranges the instruments on the sterile table for use in the next patient. The circulating nurse replaces the suction bottle and tubing with another set, and prepares the operating table for the patient

PRECAUTIONARY MEASURES IN BRONCHOESOPHAGOLOGIC OPERATIONS

An extreme bronchospasm is treated by carrying out the procedure for cardiac arrest (Chapter 10). Surgical intervention may be required if a sponge or part of an instrument is lost within the bronchus. Such an accident seldom occurs, but when it does the foreign body may be aspirated into the smaller bronchus within a few seconds.[16, 17]

If the patient faints, his head is lowered immediately, and if he has a reaction to the cocaine solution, Pentothal sodium and oxygen are administered.

type of disease, such as a benign or malignant tumor or lung abscess; or to remove obstructive tissue or a foreign body, to aspirate secretions, to dilate strictures; or to instill an opaque substance for diagnostic observations.[6, 11, 19]

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described previously for endoscopy procedures. The type and size of each instrument depends on the patient's age and the purpose for the procedure (Fig. 220). A routine setup may include the following:

Local set
Bite block
Laryngoscope set (Fig. 210)
Bronchoscopes (Figs. 211 and 212)
Suction tubing
Suction pumps
Aspirating tubes (Fig. 215)
Clerf bronchoscopic atomizer
Lukens or Clerf collectors
Sponges
Sponge carriers
Forceps, desired type (Fig. 216)
Bronchial dilators
Magnet, if desired
Furniture
X-ray films



Fig 220—Introduction of the bronchoscope without the laryngoscope. The fingers and thumb of the operator's left hand fix the bronchoscope lightly against the upper teeth, while the right hand introduces a metallic aspirating tube Sometimes the aspirating bronchoscope with integral aspirating canal is used (From Jackson, C., and Jackson, C L Bronchoesophagology, Philadelphia, 1950, W B Saunders Co)

Operative Procedure.—One of two standard techniques is followed to introduce the bronchoscope (Figs 220 and 221). It may be inserted through the laryngoscope into the trachea. This method is generally used if there is a possibility that the patient may suffer from asphyxia. By using this method the lingual, pharyngeal, and laryngeal regions can be cleared and aspirated imme-

1 Laryngeal forceps, cup and up-biting type (Fig. 216)
2 Sponge-carrier forceps and sponges
2 Towel forceps
1 Laryngeal syringe and cannula, if desired
2 Safety pins
1 Specimen jar

Operative Procedure.—

1. The bite block is inserted; the secretions are aspirated with aspirating tube.

2. The spatular end of the laryngoscope is introduced into the right side of the patient's mouth, directed toward the midline; then the dorsum of the tongue is elevated, exposing the epiglottis.

3. The patient's head is first tipped backward and then elevated and lifted upward as the laryngoscope is advanced into the larynx.

4. The larynx is examined, a biopsy is taken, and secretions are aspirated. The laryngoscope is removed. The patient's face is cleansed. The patient is reassured and taken to his room.

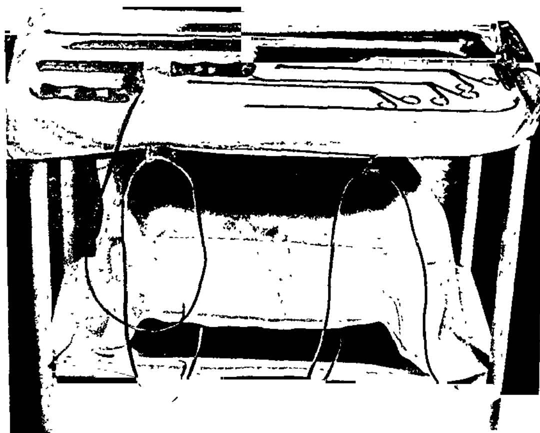


Fig 219 —Bronchoscopy setup. (Courtesy Dr. David Jones, New York, N. Y)

Bronchoscopy

Definition.—Insertion of a long, rigid tube, known as a bronchoscope.

Purposes.—To assist the physician in diagnosing a disease involving the tracheobronchial tree, to discover the source of a hemorrhage, to determine the

6. Specimens may be taken for pathologic examination. Sponges may be used to remove secretions that are adhering to the bronchi. Double suction setup may be required.

7. Tracheal mucosa is examined. The tube is passed down the trachea into the carina and the main bronchus, then into the right main bronchus, the left bronchial tree, and the posterior and anterior branches of the bronchi. The patient's head is deflected to the left by the assistant so that the operator can pass the bronchoscope into the right bronchi; then the head is deflected to the right when the left bronchi is examined. The patient's head is raised when the posterior bronchi are examined. A special bronchoscope may be used to remove foreign bodies. Suitable forceps are needed to remove foreign bodies (Fig. 214).

8. The bronchoscope is removed. The patient's face is cleansed.

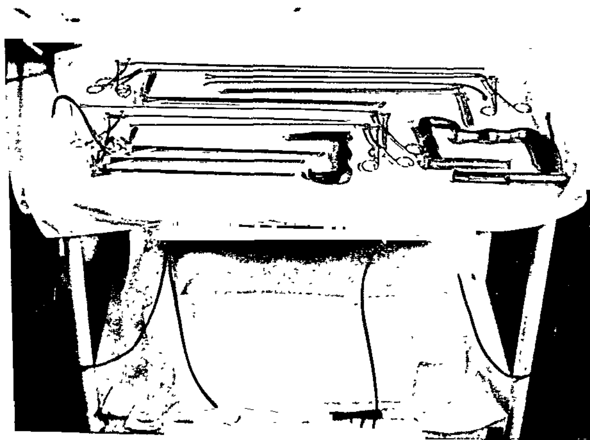


Fig. 222.—Esophagoscopy and biopsy setup. (Courtesy Dr. David Jones, New York, N. Y.)

Esophagoscopy

Definition.—Insertion of an esophagoscope into the esophagus and the cardia of the stomach.

Purpose.—To treat inflammatory strictures of the esophagus, such as lye strictures, congenital stenosis, or varices of the esophagus, or to make a direct visual examination of the esophagus to determine the source of bleeding.[1, 10, 13]

diately. The second method is the direct introduction of the bronchoscope through the mouth into the larynx and bronchi without the aid of the laryngoscope (Fig. 221).

The steps and items, as shown in Figs. 219 to 221 for bronchoscopy, include the following:

1. The larynx is exposed, as for a laryngoscopy.

2. The trachea may be sprayed with a 4 per cent solution of cocaine, or a specially prepared topical anesthetic drug to control the gag and cough reflex so that the bronchoscope can be inserted. A Clerf bronchoscopic atomizer and spray, 45 cm. long, are needed.



direct laryngoscope. Recumbent patient. The first as-
ch is elevated above the table level. The second assistant
The fingers of the operator's right hand pull the upper
etween the teeth an
nurse is holding the bronchoscope in proper position for
handle to the right Notice the light cord and the suction
scope ready for immediate us (From Jackson, C, and J
Philadelphia, 1950, W. B Saunders Co)

3. The bronchoscope is passed through the laryngoscope; its distal end is directed to the left, the vocal cords are identified, and the scope is passed between them (Fig. 222).

4. The laryngoscope and slide are removed, and the bronchoscope is advanced to a desired position in the main bronchus.

5. An aspirating tube may be inserted to remove material from the tracheobronchial tree if the lungs are flooded.

Operative Procedure.—The patient is placed on the operating table, lying on the left side with the left elbow pulled from under the chest, and the right arm supported by an armrest. His head is elevated by a pad or pillow so that the mouth is on a horizontal plane with the suprasternal notch. During the examination his head is slightly turned so that the mouth is close to the edge of the table. The assistant operator supports the patient by standing behind him and holding his right hand against the patient's axilla.[1]

The gastroscope is lubricated with surgical jelly. The assistant operator holds the proximal end of the gastroscope in his left hand and the inflation bulb with his right hand.

The operator passes the gastroscope into the patient's mouth, directs it toward the hard palate over the base of the tongue between the cricopharyngeous muscle, inserts the scope into the esophagus, and then into the cardia of the stomach. Air is introduced into the stomach, the fluid is aspirated, and a biopsy is taken, if necessary.

REFERENCES

1. Benedict, E B: Endoscopy, ed 1, Baltimore, 1951, Williams & Wilkins Co
2. Jackson, C, and Jackson, C. L.: Bronchoesophagology, Philadelphia, 1950, W. B. Saunders Co.
3. Kernan, J. D: Bronchoscopy and Bronchography in Otolaryngology, Hagerstown, Md, 1955, W. F. Prior Co, vol 4, chap. 27.
4. Jackson, C, and Jackson, C. L: Diseases of the Nose, Throat, and Ear, Including Bronchoscopy, Esophagoscopy, and Gastroscopy, Philadelphia, 1945, W. B. Saunders Co.
5. Broyles, E. N.: New Type of Bronchoscope With Telescope, Tr. Am. Bronchosc Soc. 11:114, 1948.
6. Jackson, C, and Jackson, C L: Surgery of the Larynx, Trachea and Endoscopic Surgery of the Bronchi; in Dean, Lewis Practice of Surgery, Hagerstown, Md, 1948, W. F. Prior Co, vol. 4, chap. 7.
7. Emerson, E. B, Jr.: Aspirating Bronchoscope for the General Surgeon, Obstetrician, and Anesthetist, J. A. M. A 147:1239, 1951
8. Emerson, E. B, Jr.: A Safe and Positive Method of Tracheobronchial Aspiration on the New Born, J. A. M. A. 144.633, 1950
9. Benedict, E. B: An Operating Gastroscope, Gastroenterology 11:281, 1948
10. Schlinder, R: Gastroscopy, ed 2, Chicago, 1950, University of Chicago Press.
11. Allen, J, Harkens, H, Mayer, C, and Rhoads, J: Surgery, Philadelphia, 1957, J B. Lippincott Co, chaps 43, 44.
12. Anderson, I G, and Spaulding, E H: Infections, J. A. M. A. 147:1336, 1951.
13. Hall, J S.: Diseases of the Nose, Throat, and Ear (Handbook for Students and Practitioners), ed 5, Baltimore, 1952, Williams & Wilkins Co
14. Lederer, F L: Diseases of the Ear, Nose, and Throat, ed. 6, Philadelphia, 1952, F. A. Davis Co.
15. Powers, Agnes: Notes for Nurses on Care of Instruments, Materials and Clinic Routines in Bronchoscopic Clinic, Philadelphia, 1950, George P. Pilling and Son Co
16. Best, C H: Physiological Basis of Medical Practice, ed. 5, Baltimore, 1950, Williams & Wilkins Co, chap. 34
17. Callander, C L: in Anson, B. J, and Maddock, W. G (eds): Surgical Anatomy, ed. 13, Philadelphia, 1952, W. B. Saunders Co.
18. Churchill, F D: Primary Carcinoma of the Lung, J. A M. A. 137:455, 1948.
19. Sweet, R H: Surgery of the Chest, ed. 2, Philadelphia, 1954, W. B Saunders Co

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for bronchoesophagologic operations. Instrument setup may include the following:

- Local setup
- Esophagoscope, standard size 9 mm. lumen, 45 cm. long. For lesions in the cardia of the stomach, 9 mm. lumen, 55 cm. long. For removal of foreign body and inspection and dilatation of cervical esophagus, 9 mm. lumen, 30 cm. long. For passage of bougies, 8 mm. lumen, 45 cm. long, or Schindler esophagoscope
- Aspirators
- Suction tubing
- Suction pumps
- Eosphageal lumen finder, or bougie No. 22 F
- Forceps, length 50, 53, or 60 cm. (Fig. 215)
- Bronchoscope
  - Insufflation tube
  - Clerf dilators, if desired
- Plummer or Jackson bougies
- Broyles dilators
- Specimen containers

Operative Procedure.—The esophagoscope is introduced in a vertical position into the mouth to the right side of the tongue and along the posterior pharyngeal wall. An esophageal bougie No. 22 F or a lumen finder may be passed between the closed cricopharyngeous stricture before the esophagoscope is passed through the thoracic portion of the esophagus. Suctioning is done.

The patient's head is lowered and moved usually to the right to keep the instrument and the esophagus in a straight line, thus permitting the operator to pass the scope through the hiatus esophageal opening in the diaphragm.

The lining of the stomach is examined, the secretions are aspirated, a foreign body is removed, strictures are dilated, or a biopsy is taken. The esophagoscope is removed, and the patient is returned to his room.

Gastroscopy

Definition.—Direct visual examination of the interior folds of the stomach *by means of a flexible gastroscope with a lens system or by an open*-tubed rigid gastroscope.

Purposes.—To aid the physician in diagnosing persistent pressure symptoms in the gastrointestinal tract when the x-ray report is negative, to differentiate between gastritis or a malignant lesion, or to detect gastric polyps and ulcers.

Setup, Precautions, Skin Preparation, and Draping Procedure.—As described for an endoscopy procedure. Instrument setup may include the following:

- Flexible gastroscope (desired model) and attachments
- Aspirating tube or polyethylene tube
- Flexible gastroscopic forceps, No. 11 F, cup-shaped jaws
- Clerf specimen collector for Benedict aspirating tube
- Lubricant
- Compresses
- Emesis basin
- Suction set
- Clean gowns and gloves
- Local set

If a rigid, open-tubed gastroscope is used, the setup is placed on a low instrument table, and the surgeon wears a clean (unsterile) gown, sterile gloves, and a cap and mask.

the lesion exposed. The intercostal muscles are sutured when the wound is closed.

Arteries, Veins, and Nerves of the Intercostal Muscles.—Each muscle has an intercostal artery, a vein, and a nerve. They communicate with the internal mammary artery anteriorly and with the aortic branches posteriorly. The intercostal veins follow the course of the arteries and communicate with the mammary veins anteriorly and with the azygos and hemiazygos veins posteriorly. To prevent blood loss, the intercostal arteries and veins are clamped and sutured.

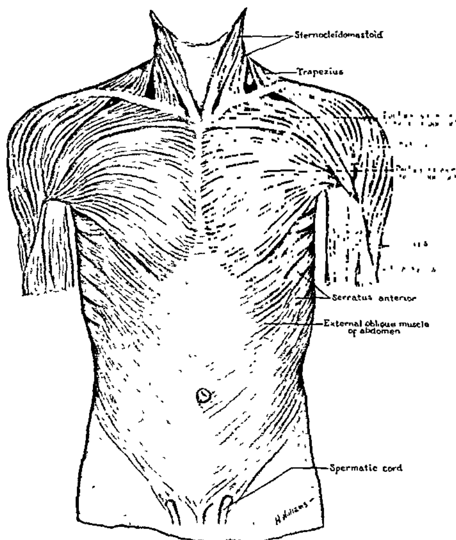


Fig 223.—Muscles of front of thorax. (From Francis, C. C, Knowlton, G. C., and Tuttle, W. W: Textbook of Anatomy and Physiology, St. Louis 1943, The C V. Mosby Co)

During surgery, great care is taken to avoid injuring the intercostal nerve which passes forward and alongside the posterior intercostal artery and which shares with the superior branch of the artery the intercostal groove on the inferior edge of the corresponding rib. Dividing or crushing the nerve or injecting an anesthetic agent may be done to prevent postoperative pain when the nerve must

CHAPTER 9

OPERATIONS ON THE THORAX AND LUNGS

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

The thorax includes that portion of the body which lies between the neck and the abdomen.[1-7] Its skeletal framework is formed anteriorly by the sternum and costal cartilages, laterally by the twelve pairs of ribs, and posteriorly by the twelve thoracic vertebras. This airtight compartment is enclosed in the root of the neck by Gibson's fascia and is separated from the abdomen by the diaphragm.

To enter the thorax, the overlying muscles must be incised or separated.[8-15] To perform most thoracic procedures, it is necessary to flex, extend, abduct, or adduct the patient's affected shoulder and arm and to extend the trunk and neck without harm to the patient. Knowledge of the origin and insertion of the involved muscles and nerves helps the nurse as she selects suitable instruments, places the patient in the proper position on the operating table or in his bed, applies a comfortable dressing or bandage, and orients the patient and her co-workers.

When a posterolateral approach is used to open the chest wall, the incision is carried through the skin, fat, fascia and muscles. It is made close to the spine so that the nerves supplying the trapezius and rhomboid muscles will not be injured.

To prevent loss of blood during surgery, the short segments of the muscles are divided and the bleeding vessels are clamped and ligated The latissimus dorsi muscle, which is an adductor and extensor of the arm, and the serratus magnus muscle, which carries the scapula forward, are both cut transversely, then freed, and retracted upward. The serratus posterior and sacrospinalis muscles of the back are also divided from their costal attachments (Figs. 223 and 225)[8,10,12,15,16]

When the anterolateral approach is used, the pectoralis minor muscle is freed from its attachment to the sternum and clavicle and divided (Fig. 224).

Muscles of the Thorax

The muscles of the thorax include the eleven external and eleven internal intercostal muscles, which fill the spaces between the ribs, and the twenty-four levatores costarum muscles, which rotate the vertebral column and flex it laterally.[3] These muscles are freed so that the ribs may be separated or removed and

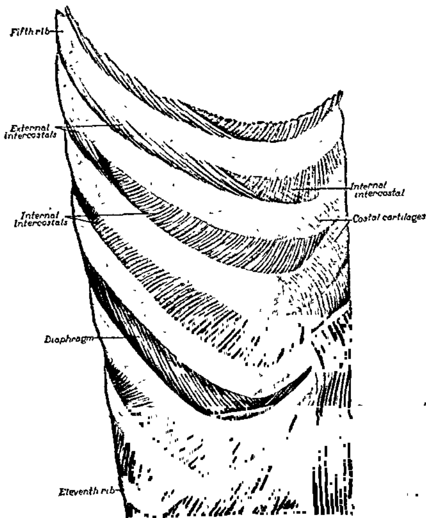


Fig 225.—Intercostal muscles of the right chest wall (From Francis, C. C, Knowlton, G. C, and Tuttle, W. W Textbook of Anatomy and Physiology, St. Louis, 1943, The C. V. Mosby Co)

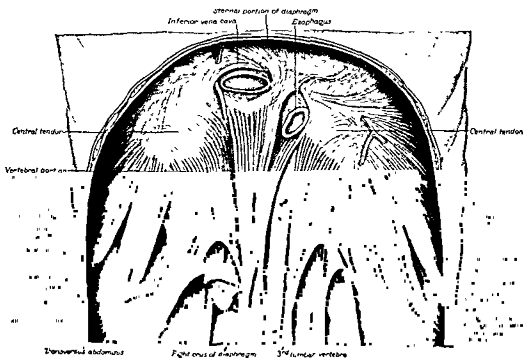


Fig 226—Abdominal surface of the diaphragm. (From Francis, C C, Knowlton, G C, and Tuttle, W W.. Textbook of Anatomy and Physiology, St. Louis, 1943, The C. V. Mosby Co)

be disturbed. The pericostal sutures are carefully placed in the muscles to avoid nerve injury and postoperative pain.

Bones of the Thorax

The sternum forms the thorax wall in the anterior median line. It consists of three parts: (1) the upper manubrium, (2) the central or the gladiolus, and (3) the lower cartilage or the xiphoid. The manubrium articulates with the clavicles and the first rib on each side; the gladiolus articulates with the remaining true ribs by separate costal cartilages; and the xiphoid fuses with the gladiolus in early development and is attached to the diaphragm by the substernal ligament. The sternal structure is involved in the funnel chest operation and in some chest injuries.[17, 18]

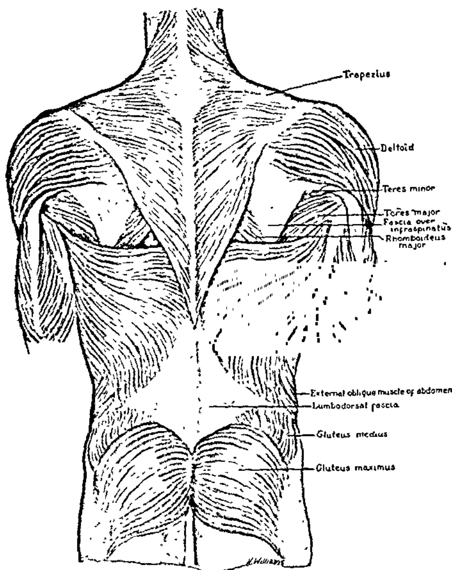


Fig 224.—Superficial muscles of back (From Francis, C C, Knowlton, G. C, and Tuttle, W. W.: Textbook of Anatomy and Physiology, St Louis, 1943, The C. V. Mosby Co)

This attachment is known as the hilus or root of the lung. Deep fissures, comprising reflections of the visceral pleural, *divide the spongy porous lung into* lobes. In performing a pneumonectomy, the visceral pleural is opened and the dissection is undertaken at the hilus with ligation of the pulmonary artery, the veins, the bronchus, and the closure of the bronchial stump.[21, 22] The primary bronchi divide, then subdivide in each lobe and eventually become bronchioles (Fig. 227). The right lung has an upper, middle, and lower lobe, and the left lung has only an upper and lower lobe.[23] However, the lungs are similar in that they are composed of ten major segments. Each segment extends to the pleural surface, expanding in volume from its center to its peripheral edges. Each segment also has its own bronchus and branches coming from the pulmonary artery and vein. In a segment resection of a lobe, its own bronchus and the arterial and venous branches are dissected and ligated (Figs. 228 and 229).

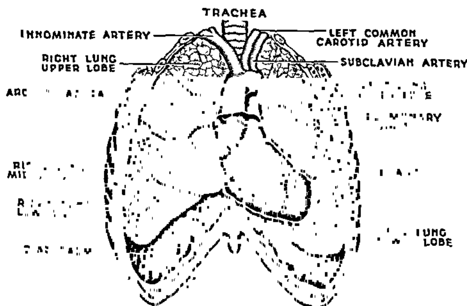


Fig 227—Organs of the thoracic cavity. Part of the pericardium has been removed to expose the heart. (From Zoethout, W. D, and Tuttle, W. W.: Textbook of Physiology, St Louis, 1952, The C. V. Mosby Co)

The bronchial arteries, arising from the aorta, are systemic and supply nourishment to the lungs. There are variations in their number and course.[6, 15, 16, 20] The arrangement may include two branches to the left lung, and one branch to the right lung, which later branches into two—or one branch for each lung, or two branches for each lung. The pulmonary arteries and veins (a part of the pulmonary circulation) aerate the venous blood in the lungs.

The nerves of the lung are a part of the autonomic nervous system. They regulate the diameter of the bronchi and that of the blood vessels within the lungs.

Respiratory Physiology

Thoracic Injuries and Intrathoracic Conditions.—Although the thoracic cavity is an airtight space, the lungs communicate with the outside air by means

At the posterior end of each rib there is a head which articulates with the head of its corresponding thoracic vertebras and that of the vertebras just above it. A second articulation exists between the tubercle of the rib and the vertebral transverse process. *In a total rib resection, as in thoracoplasty, the transverse* processes are excised; but in a partial resection, the rib is resected only posteriorly to the neck and through the cartilages anteriorly.[8, 9, 14]

Normally, the lateral walls of the thorax are formed by the twelve pairs of ribs.[3, 6, 7] Posteriorly, each pair of ribs articulates with its corresponding thoracic vertebras, but anteriorly the first seven ribs (true ribs) articulate with the sternum. The eighth, ninth, and tenth ribs articulate with the costal cartilages of the rib above. However, the eleventh and twelfth ribs do not join the sternum by means of the cartilages. The upper pair of ribs is the shortest, and each succeeding pair is longer. This construction makes the chest conical in shape with the broad diameter at the bottom of the thorax. Various operations involve different ribs To do a lower lobectomy, the pleural cavity is exposed by resecting a portion of the fifth and sixth ribs, incising the intercostal muscles, and then holding the ribs apart, using a self-retaining retractor.[5, 9, 10, 12, 16]

The diaphragm, which consists of three muscular sheets or leaves, is actually a muscular septum.[3, 6] It separates the organs in the chest cavity from those in the peritoneal cavity. The chest cavity is subdivided into two pleural cavities which contain the lungs. The mediastinum lies laterally between the pleural membranes, and the mediastinal space divides the pleural cavity. A membrane known as the parietal pleura lines the inner surface of the thorax. This membrane is closely associated with the inner surfaces of the ribs posteriorly, with the mediastinum laterally, and covers the surface of the diaphragm except at the central portion. A portion of the parietal membrane is reflected back at the root of each lung to form a sac around it. This parietal reflection is called the visceral pleura. A serous secretion existing between these two membranes keeps them moist.

At the axis of the trachea, the left bronchus has a greater deviation than the right bronchus and the latter is somewhat shorter and wider.[3, 7, 15, 19, 20] For this reason, foreign bodies are more likely to pass into the right bronchus than into the left one. A septum, known as the carina, which divides the left and right bronchus, moves from its midline when the person breathes. Because the tracheobronchial tree is fairly movable within the thoracic cavity, it makes the introduction of the endoscope easier. When a person breathes in air, the bronchi elongate and expand, but during expiration, they shorten and contract. Due to stimulation of the vagal nerve branches, the bronchial tubes may become constricted, and this in turn causes coughing. Because there are fewer vagal branches in the smaller bronchioles, the constriction can be controlled with an anesthetic drug[3, 15] (Fig. 227)

The lungs are the essential organs of respiration. The base of each lung rests on the diaphragm, whereas its apex (upper end) projects into the base of the neck at a level below the first rib. At a point on the mediastinal surface of each lung, there is an attachment at which the bronchus, the nerves, the lymphatics, and the pulmonary and bronchial vessels enter and leave the lung.

of the bronchi, trachea, and nasal passages. The main function of the lungs is to bring venous blood into contact with the inspired air.[1, 2, 5, 12, 24] Normally, as the thorax increases in size, the lungs expand and draw in air, and as the thorax decreases, it forces the air out. Breathing normally takes place when the intrapleural pressure is slightly below atmospheric pressure (76 cm. of mercury or 760 mm. mercury, standard value, or zero), and when a partial vacuum exists between the parietal and visceral pleural (intrathoracic) surfaces.[5, 6] As the thoracic muscles of inspiration contract to enlarge the chest cage, the lungs possessively follow the diaphragm and chest wall due to the increased pressure which exists. The act of inspiration and expiration is the result of air moving in and out so that the pressure almost equalizes that of the atmosphere.

The normal intrapleural pressure varies from −9 to 12 cm. of water on inspiration, and from about −3 to 6 cm. of water during expiration. The greatest amount of air that can be expired after a maximum inspiration is termed the vital capacity of the lung. The size and vitality of the person influence the amount of expired air. (Fig. 230.) Any condition which interferes with the

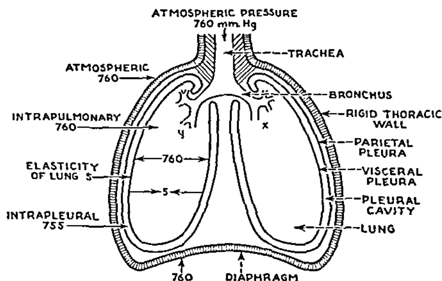


Fig 230.—Diagram illustrating the intrapulmonary and intrapleural pressures with the chest wall in the resting position (From Zoethout, W. D, and Tuttle, W. W.: Textbook of Physiology, St. Louis, 1952, The C V Mosby Co)

normally negative intrapleural pressure generally has a serious effect on respiratory function. Due to pulmonary disease, the lung is unable to expand so that its normal vital capacity is lowered from 73 to 43 per cent. The patient may suffer from anoxia due to diminished respiratory function and to diminished cardiac output.[4, 17, 25] The most common conditions which interfere with cardiorespiratory function are closed pneumothorax, simple and tension types, open pneumothorax, hemothorax, and multiple rib injuries which produce paradoxical motion of the thoracic cage. (Fig. 237.) Surgical operations designed to prevent such conditions are described later in this chapter.

As previously mentioned, the normal function of the "pulmonary bellows" is due to the elasticity of the lungs and to the outward traction of the negative

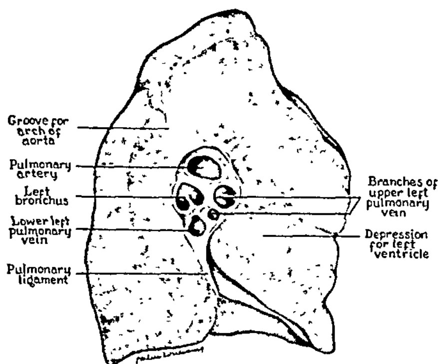


Fig. 228.—Medial surface of the left lung. (From Francis, C. C, Knowlton, G C, and Tuttle, W. W.: Textbook of Anatomy and Physiology, St. Louis, 1913, The C. V. Mosby Co)

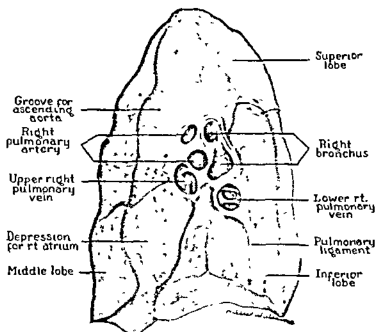


Fig. 229—Medial surface of the right lung (From Francis, C C, Knowlton, G. C., and Tuttle, W. W.: Textbook of Anatomy and Physiology, St Louis, 1913, The C. V. Mosby Co)

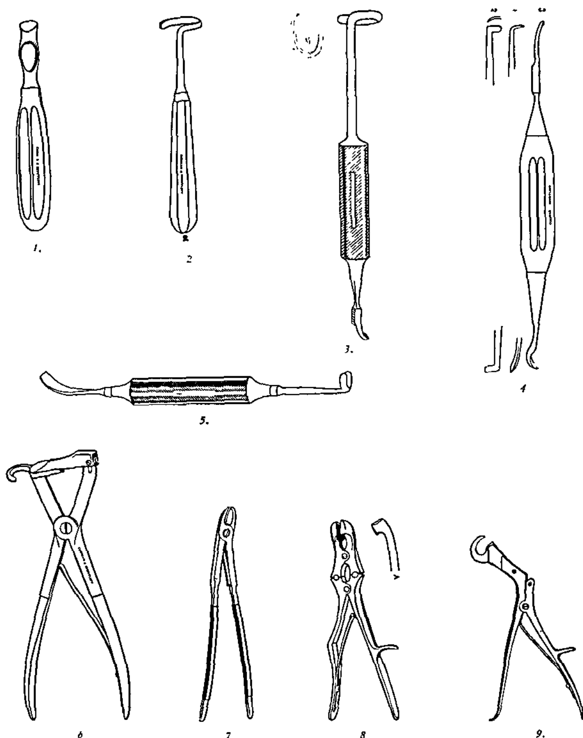


Fig 231.—Instruments for opening chest wall· *1*, Kermisson periosteal raspatory, 6½ inches, curved or straight type, *2*, Doyen rib raspatory, right or left, 6 inches, adult or child size, *3*, Wilson rib stripper, adult and child size; *4*, Overholt elevator, Nos 1, 2, and 3. *5*, Lambert-Berry raspatory, double-ended, 11 inches, *6*, Shoemaker rib shears, child size, 8¼ inches, and adult size, 9¼ inches, *7*, Bethune rib shears, 13½ inches, *8*, Sauerbruch rib rongeur, straight, multiple action, round jaw, 17 and 20 mm widths, also available with square jaw of various widths, and curved multiple-action, square jaw, 13, 15, 17, and 20 mm widths; *9*, Stille-Giertz rib shears, 9¾ inches, stainless steel The instruments as shown are one-third actual size. (Courtesy Codman & Shurtleff, Inc , Boston, Mass)

intrapleural pressure. If the lung is not adherent to the chest wall, collapse of the normal lung will follow any condition which lowers the negative intrapleural pressure.[4, 5, 11, 12] When the pleural space is filled with air, reducing the negative pressure, the lung contracts. This action may cause a complete collapse if the pressure within the intrathoracic (pleural) space becomes positive.

Also, a diminished negative pressure or the occurrence of actual positive pressure in one pleural space may cause a shift of the mediastinum toward the opposite side. When this happens, not only will the affected lung collapse because of a positive pressure in the pleural space, but the function of the lung on the opposite side may also be impaired due to the compression by the shifted mediastinum. Tension pneumothorax can produce serious effects as air continues to escape from the lung into the intrapleural. The air is unable to return to the bronchi to be exhaled, thereby increasing the intrapleural pressure which usually causes the lung to collapse, but also diminishes the air leak on that side. However, when there is a large opening in the chest wall which allows direct communication of the pleural space with atmospheric pressure, it may cause death if the mediastinum is normally mobile. The exposure of the pleural space to atmospheric pressure collapses the affected lung; also, the positive pressure is transmitted to the mediastinum, which, in turn, shifts toward the opposite side. Its presence may cause the opposite lung to collapse.

Paradoxical motion of the chest also involves the mediastinum. Pressure changes which are associated with respiratory movements of the unaffected lung are transmitted through the mediastinum to the affected side.[5, 19] Paradoxical respiration, which is the reverse of normal respiration, causes the mediastinum to shift into the unaffected side of the chest cavity with the result that the lung on this side also is not fully inflated. Pulmonary ventilation is reduced, rebreathing of air from one lung to the other occurs, and venous return to the right side of the heart is impaired. In such a condition, the patient should be kept on his affected side in order to mobilize the affected lung and to permit the unaffected one respiratory freedom Surgical treatment is described later in this chapter.

PRECAUTIONARY MEASURES IN THORACIC OPERATIONS

The patient should be placed on the operating table in a position which will provide for adequate exposure of the operative site, respiratory and circulatory functions, and good body alignment (Chapter 4). The vital capacity of the lung and venous return of blood to the right heart is influenced by the position of the patient. Because a supine position tends to lower the vital capacity, it is easier for the cardiac patient to breath when he is in a slight reverse Trendelenburg position (Chapter 4).

In caring for a patient with poor collateral circulation, the lower extremities should not be elevated since blood cannot run uphill.[2, 10, 16, 24, 26] The operating table is usually returned to a horizontal position so the ribs can be approximated more readily. Since an abrupt change in the patient's position

secretions. Parenteral therapy is necessary to maintain body salts and a fluid balance.

Before the chest wound is closed, the lungs are reinflated after intermittent suctioning through the endotracheal tube. An artificial pneumothorax may be done to remove the remaining intrapleural air, and a radiograph may also be done to determine the existing intrapleural and pulmonary pressures. A bronchoscope should be available to remove large plugs of mucus deep in the tracheobronchial tree, and if used, the patient is gently turned, as a whole and not in parts, onto his back; then the bronchoscope is introduced (Chapter 8).

In treating a patient with tension pneumothorax, an intercostal catheter is attached to a water-seal bottle or a Wangensteen type of suction setup (Fig. 234).[5,16,27,28] If the lung does not re-expand readily because of a persistent

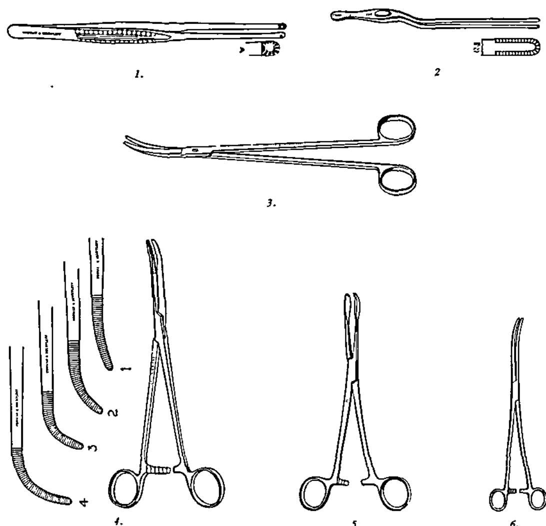


Fig 233.—Dissection instruments for lung and cardiovascular operations 1, Mayo tissue forceps, fenestrated handle, 9 inches, 2, Harrington-Mayo bayonet tissue forceps, 14 inches; 3, thoracic scissors, 10 inches, straight or curved, frequently used in sympathectomy and pneumonectomy; 4, Rumel thoracic forceps in four sizes, with different angle curve, 5, Overholt segmental forceps for lung operations, 6, Harrington clamp forceps, curved or angular, 11½ inches. Instruments as shown are one third actual size (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

may result in serious vasomotor disturbances, the worker should always change the position of the patient slowly (Chapter 4).

Specific instruments, as shown in Figs. 231 to 233, are required for various operations (Chapter 4). Suitable retractors are needed to expose a particular region, an organ, or a blood vessel. Localized pleuritis and pleural pain may follow due to the use of improper retractors. Gentle pressure can only be accomplished if the correct instrument is used. Trauma is diminished by the placement of a moist pad between the organ and the retractor. Hemostasis is controlled with suitable forceps and swaged-on sutures (Chapter 5). It is imperative to provide adequate equipment for suctioning away the bronchial

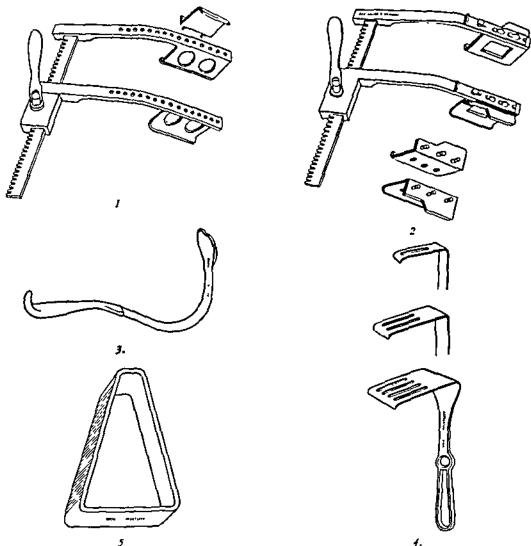


Fig. 232.—Retractors for thoracic operations: *1*, Burford-Finochietto rib retractor with two sets of detachable blades (arms curved to fit contour of the body; large blades, detachable, 2⅝ inches wide by 2¾ inches deep; small blades 2⅝ inches wide by 1¾ inches deep). *2*, Harken rib retractor with two detachable scapula blades (arms curved to fit contour of the body); arms have a series of holes into which the scapula blades fit (scapula blade not used routinely, only when specifically requested); *3*, Harrington splanchnic retractors, 12½ inches long; blade end 1½ or 2½ inches wide, with or without light carrier and bulb; *4*, Coryllos retractors in three sizes, with different-sized blades, ranging from 3¼ inches by ⅞ inch to 4½ inches by 2½ inches for blade; *5*, New York Hospital spreading wedge used for emergency care. Instruments as shown are one third actual size. (Courtesy Codman & Shurtleff, Inc., Boston, Mass.)

secretions. Parenteral therapy is necessary to maintain body salts and a fluid balance.

Before the chest wound is closed, the lungs are reinflated after intermittent suctioning through the endotracheal tube. An artificial pneumothorax may be done to remove the remaining intrapleural air, and a radiograph may also be done to determine the existing intrapleural and pulmonary pressures. A *bronchoscope should be available to remove large plugs of mucus deep in the* tracheobronchial tree, and if used, the patient is gently turned, as a whole and not in parts, onto his back; then the bronchoscope is introduced (Chapter 8).

In treating a patient with tension pneumothorax, an intercostal catheter is attached to a water-seal bottle or a Wangensteen type of suction setup (Fig. 234).[5,16,27,28] If the lung does not re-expand readily because of a persistent

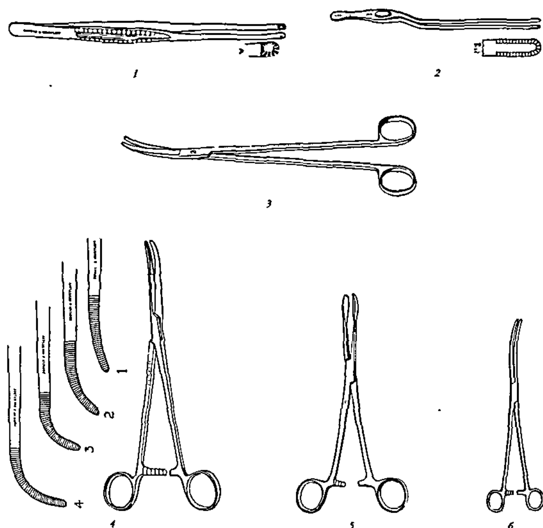


Fig 233.—Dissection instruments for lung and cardiovascular operations: *1,* Mayo tissue forceps, fenestrated handle, 9 inches; *2,* Harrington-Mayo bayonet tissue forceps, 14 inches; *3,* thoracic scissors, 10 inches, straight or curved, frequently used in sympathectomy and pneumonectomy; *4,* Rumel thoracic forceps in four sizes, with different angle curve; *5,* Overholt segmental forceps for lung operations; *6,* Harrington clamp forceps, curved or angular, 11½ inches. Instruments as shown are one third actual size (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

air leak, suction usually is applied, using a two- or three-way suction bo
as shown in Fig. 234.

When air accumulates in the chest wall, it not only affects the positi
mediastinum, but also the flow of blood in the vessels. During some
procedures, one catheter may be introduced into the upper region of
cavity to remove the air and a second introduced into the lower the
gion to drain off the serous fluid.

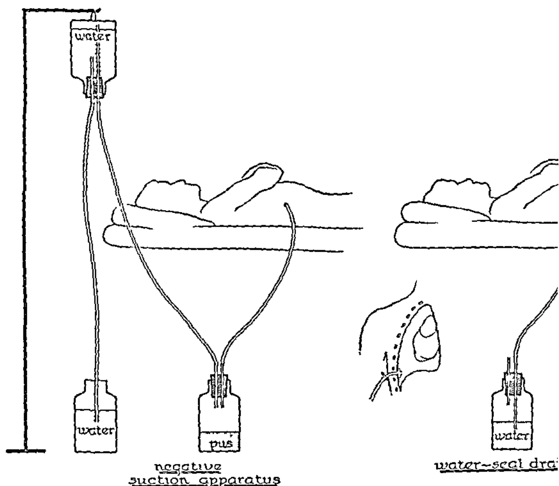


Fig. 234.—*Water-seal and suction drainage In treating a patient with tension* thorax, an intercostal catheter is attached to a water-seal bottle or Wangensteen type setup. If the lung does not re expand readily because of a persistent air leak, sucti is applied, using a two or three way suction bottle setup. (From Moseley, H. F.: Te Surgery, St. Louis, 1956, The C V Mosby Co.)

The patient should remain on the operating table until he is able to
normally; oxygen therapy may be administered. To prevent aspiratio
cretions, the patient is usually placed on his operative side with his h
ered slightly.

POSITIONING THE PATIENT FOR A THORACIC OPERAT

Lateral Position

Purposes—Lateral position aims to provide freedom of respiratory and circulatory functions; to decrease strain and tension on the muscles, blood vessels, and nerves; to prevent the spread of pathogenic organisms; and to provide for adequate exposure of the lesion.

Advantages.—A right or left lateral position can give the surgeon access to both the anterior and posterior surfaces of the lung and blood vessels. With the patient in this position, the intercostal muscles on the unaffected side are slightly narrowed, while those on the affected side are widened, thus providing a wider wound exposure. Slanting the upper section of the table downward at a 10-degree angle places the trachea and mouth at a level lower than the lungs. This encourages the bronchial secretions and fluids to drain into the mouth and not to pass into the unaffected side of the chest.

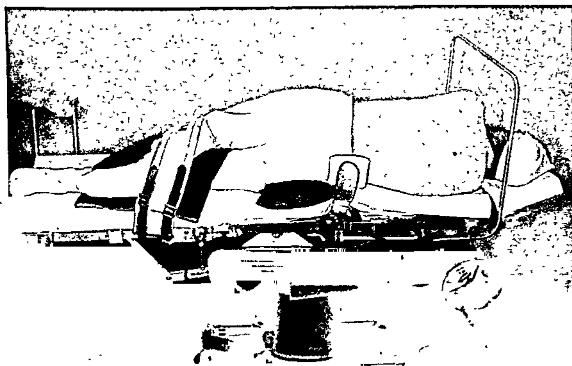


Fig. 235—Lateral position. The patient is placed on the operating table, with the affected side uppermost and the back near the edge of the table The shoulders should be vertical, the arms and legs supported, and the body stabilized

Precautions.—The hazards of carbon dioxide retention are present with the patient in a lateral position, and respirations and blood pressure rates can be affected due to constriction of the chest.[29] The ulnar nerve, external popliteal nerve, and spinal column must not be compressed against bone. Good body alignment must be preserved by means of pads and pillows. (Chapter 4.)

Items.—A modern operating table with adjustable sections adequately covered with a sponge-rubber mattress, 1 narrow oblong sponge rubber support, 1 small square pad, 1 brace with pad (if desired), 1 large pillow, 2 small pads, armrest, leg strap, and anesthetist's screen.

Procedure.—The circulating nurse and a co-worker carry out a procedure which will meet the surgeon's preferences and protect the patient from physical

and emotional trauma. The steps include the following: Greet patient by name if he is awake. Check his chart according to admission rules and his name with listing on schedule of operations; then take him to the operating room unit (Chapter 4).

Transfer the patient to the table; place him in a supine position with his shoulders over the break of the upper section of the table. Place a pillow under his head and shoulders, and secure a leg strap over his legs at a point above the knees. Make sure a skin area is against the table pad. Place his arms in a restrain sheet, or hold his hands during induction of the anesthetic. Stay with the patient until he is asleep; then release the leg strap.

Remove the patient's gown, turn down the sheet, and then turn him onto his unaffected side, bringing his back near the side of the table.

Straighten his back, and place a small square pad under the chest region to elevate the proposed operative site.

Pull his underneath arm well away from his body. Place a thin sponge-rubber pad under his unaffected axilla to prevent him from falling forward and to relieve tension on the abdominal and spinal muscles. Slightly flex his unaffected elbow to relieve strain on the brachii plexus and ulnar nerve, and place this arm on the table or on a padded armrest (Chapter 4).

Slightly abduct his affected arm and scapula forward; slightly flex the elbow, and rest the arm and hand on the head section of the table, or on a Mayo stand which has been placed over the table. The shoulders must be kept vertical.

Straighten his underleg and slightly flex other knee to prevent him from falling forward. (If a more prone position is preferred, straighten the uppermost leg and slightly flex the underknee.) Do not flex the knee at an angle which will cause the leg to press against the abdomen since the pressure may result in diaphragmatic embarrassment. (Fig. 226.) Place one pillow between his legs to prevent the bones from pressing on the nerves; then secure the leg strap over the legs. Place a pad under the foot of the upper leg and secure foot to table, using a small pad and muslin bandage.

If desired, attach a short padded brace to the kidney elevator; slide it along the rack against his back, and place a small pad under his buttocks. Go to the other side of the patient, and secure an oblong pad in the restraint sheet to support the abdomen. The upper section of the table may be broken to elevate the chest region. If desired, slant the table slightly downward so that the head is lower than the feet. Focus the lamp over the proposed operative site.

Anterolateral Position

Uses.—For transthoracic or transsternal approach to remove the middle lobe or the right upper lobe, or to treat a congenital heart lesion.

Items.—A modern operating table, small pillow, large pillow, oblong pad, small rectangular pad, leg strap, and ether screen; armrest, if desired.

Procedure.—The principles of good positioning are followed (Chapter 4). The steps are as follows: (1) Place the patient on the operating table in a supine position, with his affected side near the edge of the table and his shoulders at

the upper break of the table. (2) Place a pillow under the head and neck. (3) Secure his unaffected arm and hand at his side, in the flaps of the left sheet, with his palms downward and fingers relaxed. (4) Abduct his affected arm slightly and then flex the elbow and rest the arm near his head, or place the arm on a Mayo standard which is padded with a folded sheet (Fig. 98). (5) Place a small pad under his chest region and another one under shoulder and axilla. (6) Place one small pad under his lumbar curvature, a pillow under his knees, and a second small pad under his ankles to prevent footdrop and relieve pressure on the medial calf. (7) Secure the leg strap over the legs above the knees. This position is similar to a supine position described in Chapter 4.[29]

Prone Position

Uses.—For pulmonary resection in treating tuberculosis or bronchiectasis.

Purposes.—To prevent the spill-over of bronchial secretions in the diseased lesion from crossing the carina and flowing into the healthy bronchus and to decrease the possibility of the mediastinum shifting to the unaffected side.

Precautions.—The patient's arms should not hang below his body since prolonged strain causes injury to the nerves and ligaments. His neck is kept in front on a plane with the body. The respiratory and circulatory functions must not be restricted by table appliances or by poor body alignment. (Chapter 4.)

Items.—Operating table, 2 adjustable supports for shoulders, and 1 adjustable ring-type headrest, 2 oblong sponge-rubber pads or folded sheets to support chest region, 1 pillow and pad for the legs, leg strap, and armrests, if desired. Overholt modification appliances may be used.

Procedure.—Place the patient on the operating table, with his face resting in the ring of the head support and the outer aspects of his shoulders on the shoulder supports. The shoulders should not be allowed to fall forward. Adjust the supports so that the head and body are in good alignment. If shoulder supports are not attached to the table, place a sponge rubber pad under each shoulder.

Place an oblong sponge-rubber pad or rolled sheet beneath each side of the patient between the end of the rib cage and the upper abdomen to permit easier breathing. Extend and support the arms and hands on an armrest attached to the table on each side or secure the arms at the sides in the flaps of the lift sheet.

Support the lower portion of the legs with a pad of sufficient height to keep the toes from touching the table, thereby preventing plantar flexion. If desired, secure leg strap around the table over the legs just above the knees.

In some operating rooms a special sponge-rubber pad is used which is designed to provide support for the shoulders and hips and has an opening in it to permit free respiration and minimize abdominal compression.

A padded footpiece may be attached at a right angle to the table when its lower sections are broken, so that the legs rest against the table; knees are at the break, and feet rest over the upper edge of the footpiece. A folded sheet or rubber pad is also placed under the knees. This position helps to relieve pressure on the legs and pressure exerted on the back by the operators.

Upright Position

Purpose.—To help prevent the purulent sputum from passing into the lungs, especially in adults with bilateral bronchiectasis, and in children with copious secretions.

Items.—A small pad, large pad, leg strap, pillow, footpiece, and anesthetist's screen.

Precautions.—Since this position may cause undue strain on the heart, the patient's blood pressure readings are frequently taken (Chapter 4). An endotracheal tube is generally introduced and the bronchial passageway is suctioned.

Procedure.—The circulating nurse and co-worker carry out a procedure which meets the surgeon's preferences and protects the patient from harm, as described in Chapter 4. The footpiece and pad are attached to the table before the patient arrives. He is placed in a supine position, and then turned slightly onto the unaffected side with the shoulders at a level with the break of the table. His body is supported with pads. The upper section of the table is elevated.

SKIN PREPARATION AND DRAPING PROCEDURE

Routine skin cleansing procedure is carried out (Chapter 3). The immediate area surrounding the proposed line of incision is draped with large towels or small sheets and held in place with towel forceps. The type of sheet used will depend on the location of the lesion, the incision to be made, and the age and size of the patient (Chapter 4).

For some operations four large towels or four small single sheets and a fenestrated sheet are used. For an infant, a fenestrated sheet with a small window or four small sheets may be used. The fenestrated breast sheet or laparotomy sheet may be used for adults having a lobectomy. A chest sheet with a large opening designed to expose the line of incision is more efficient for a pneumonectomy (Chapter 4).

If the patient is to be draped with single sheets, one fanfolded sheet (large), is draped transversely over the upper chest region and the anesthetist's screen; a second sheet (large) of double-thickness muslin is draped over the lower extremities; a third sheet (small) is placed longitudinally along the back, and a fourth sheet (small) is placed over the anterior chest region and abdomen parallel to the third sheet. The sheets are held in place with towel forceps.

INCISIONAL APPROACHES FOR LUNG SURGERY

Posterolateral Incision

A posterolateral incision is frequently used for the tourniquet method, for left or right upper labectomy, or for left or right lower lobectomy (Fig. 243).

The incision usually begins halfway between the medial edge of the scapula and the second or third thoracic spinous process. It is continued downward medially below the angle of the scapula and anteriorally beyond the end of the fifth, sixth, or seventh ribs, depending upon the location of the lesion.

Anterolateral Incision

The incisional entrance into the thorax depends on the location of the disease. An anterolateral incision is generally used for a middle lobectomy.

The incision usually begins near the sternal border at the level of the third costal cartilage, then extends downward and outward beneath the breast, continuing upward into the axilla, and ending near the posterior axillary line. In women, the incision usually follows the submammary crease. The chest cavity may be entered through the fourth or fifth intercostal space.[9, 15, 24, 30]

OPERATIONS

Funnel Chest Operation (Correction of Pectus Excavatum)

Definition.—Resection of the lowest costal cartilages, division of the xiphoid from the gladiolus, severance of the substernal ligament, and of the diaphragmatic attachments from the resected portion of the costal cartilages, and then formation of a wedged transverse osteotomy of the sternum, excision of malformed articulations, and repositioning of the ends of the cartilages.

Considerations.—A deformity of the chest wall, which is also known as trichterbrust or chonechondrosternon, is a structural depression of the anterior thoracic wall Many theories have been proposed as to its cause—fetal position in the utero, an upper respiratory tract obstruction, an inherited tendency, an obstruction in breathing that necessitates an increase amount of pull by the diaphragm, thereby increasing the negative pressure. There is discussion, however, as to which structure pulls the thorax inward.[12, 16-18, 30-34]

This deformity is characterized by a posterior depression of the sternum, which has its deepest depression at the junction of the xiphoid with the gladiolus. The sternal ends become elongated and depressed in a posterior direction, forming a narrow inverted cone or funnel-shaped configuration. This causes a compression of the thoracic viscera. The lower end of the sternum may push the mediastinum back against the anterior surface of the vertebral bodies, thus causing cardiac symptoms. It should be noted that pigeon breast is the opposite of funnel chest; instead of a funnel-shaped depression there is a protruding deformity

Surgery is done when the respiratory and circulatory systems are extensively affected. Infants have pronounced respiratory and gastrointestinal symptoms. In older boys and girls, the respiratory difficulties diminish, but exercise tolerance decreases and poor posture becomes a psychologic problem. In the adult group, the cardiac symptoms may be more pronounced which, in turn, affect the circulation by putting pressure on the heart and great vessels

Purposes.—To establish normal respiratory and circulatory functions of the organs in the chest by eliminating the abnormal downward inclination of the sternum and by straightening the attachments of the cartilages to the sides of the sternum

Sterile Setup.—A thoracotomy setup, suitable for child or adult, plus the following items:

- 1 Albee or Stryker electric saw with circular blade
- 1 Lebsche bone punch 10½ inches or hand drill and point No. 6 (optional)
- 1 Hey skull saw (optional)
- 1 Lebsche sternum or cartilage knife
- 1 Lebsche or Lilienthal sternum shears
- 1 Bethune, Sweet, or Farabeuf periosteal elevator
- 1 Schneider, Farabeuf, or Mathieu raspatory, 5¾ or 7½ inches
- 2 Davidson or Sauerbruch scapula retractors, child or adult size
- 1 Mallet
- 2 Tubes bone wax
- Silk or cotton Nos. 2-0, 0, and 1
- Stainless steel wire Nos. 0 and 1, or gauges 32 and 31
- Wire cutters
- Traction and immobilization apparatus if desired. Jacob sternal ladders, metal bridge ladders or light plaque or plaster with heavy wire loops attached, or wooden spreaders with wire loops

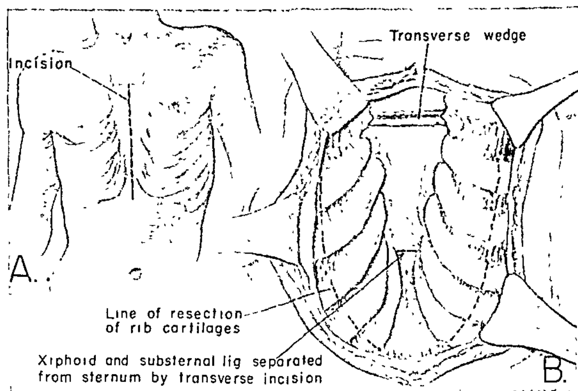


Fig 236—Operation for correction of funnel chest *A*, The deformity and line of incision *B*, The sternum has been divided. Dotted lines show division of costal cartilage. (From Horsely, G W., and Bigger, I A Operative Surgery, vol I, St Louis, 1953, The C. V. Mosby Co)

Position, Skin Preparation, and Draping Procedure.—The patient is placed in a supine position, with the upper half of the body slightly elevated by a small pillow. His head is tilted slightly backward, and the arms are secured at his sides (Chapter 4). The skin area is prepared from a level above the clavicalis, extending over the entire anterior chest region and upper abdomen at a level of two inches above the umbilicus (Chapter 3). The patient is draped with sheets.

Incision.—An anterior midline incision, as shown in Fig. 236, is made through the level of the second rib to a point halfway between the xiphoid and umbilicus (mid-epigastrium).

Operative Procedure.—The items used to perform the various steps of the operation are listed opposite each step.

Steps	*Items*
1. An incision is carried through the skin to the fascia. The wound edges are protected with towels after the bleeding is controlled.	1. Knives, tissue forceps, straight hemostats, plain or chromic gut, or silk No. 2-0 or 3-0; straight scissors, skin towels, towel forceps or silk No. 0 threaded on cutting-edge needles; 2 needle holders; (*skin instruments are discarded in basin*), *gauze sponges*
2. The fascial insertions of the pectoralis major muscles into the sternum are cut and retracted. Rib cartilages are freed from sternum (Figs. 223 to 225).	2. Angular retractors; curved scissors; elevator; moist warm, small pads; knife; hemostat; ligatures; sponges
3. A transverse incision is made, separating the xiphoid from the sternum and dividing the substernal ligament and extension of abdominal muscles.	3. Knife; periosteal elevator; long curved scissors; sternal knife
4. The xiphoid is grasped; the anterior mediastinum is entered. The pericardium is freed from the sternum.	4. Sharp and blunt dissection is used; bone-grasping forceps, elevators, sponges
5. The posterior cartilages are cut to free the depressed bone. This allows the pleura and pericardium to drop back posteriorly and the heart to shift to a normal position.	5. Heavy scissors, tissue forceps
6 A wedge-shaped transverse osteotomy is made in the outer table of the sternum at a point where the deformity begins.	6. Raspatory; circular saw
7. The sternum is trimmed; cartilages are shortened or resected so that new surfaces fit flat against each other. Depressed sternum is bent forward to assume a normal position in relation to the sternum	7 Rongeur and shears
8. The sternum is maintained in the corrected position by mattress sutures which are placed across the osteotomy. The pectoralis muscles are sutured back to the sternum; the intercostal muscles are sutured to the undersurface of the sternum; the xiphoid is left free	8. Heavy silk sutures threaded on trocar-point needles, dressings

Steps	*Items*
9. The wound is closed, dressed, and the sternum immobilized. Pleural aspiration may be done.	9. Small gauze dressings, fluff gauze or pad, metal arch bridge or similar type of apparatus; aspirating setup, if desired

Wounds of the Thorax

Physiologic Considerations and Treatment.—Many thoracic injuries are associated with injuries of the head and the abdomen and fractures of the extremities.[19, 35-37] The preparation of the operating room and patient will depend upon the type of thoracic wound and other physical disturbances.

Thoracic injuries may be grouped into several classifications:

The nonpenetrating thoracic wound, which has no external opening and is caused by severe coughing, by straining, or by contusion.

The valvelike penetrating thoracic wound, which has an opening between the thoracic spaces and the outside, thus permitting air to accumulate in the chest. This condition results from traumatic injury or disease. The air may come from the outside through an open wound, or from the lung as a result of a ruptured tuberculous cavity. In both situations, the gases in the pleural cavity are slowly absorbed by the tissues until the lung can assume its normal function.

Operative Procedure.—The air may be aspirated by using a pneumothorax apparatus; it is withdrawn by the flow of water from one bottle to another. The intrapleural pressure is determined at intervals, and a sufficient negative pressure is maintained to prevent further leakage.[38, 39]

Open Penetrating Wound.—This condition, which is known as an open pneumothorax, permits air to reach the pleural cavity with each inspiration, but with each expiration it is partially removed. This condition builds up a positive pressure in the pleural cavity (see physiologic considerations mentioned previously). The dangers of open pneumothorax depend on the individual's vital capacity and the size of the external wound.[5, 12, 38] If the vital capacity is low and the tidal air is almost equal to it, a small chest wound usually closes by itself within a short period of time However, a large penetrating wound causes the lung on the affected side to collapse. This condition decreases the capacity of the opposite lung and increases the pressure in the thoracic cavity. (Fig. 237.)

Emergency Treatment.—Application of petrolatum gauze packing and a tight binder to prevent the ingress of air.

Operative Procedure.—Cleansing of wound, débridement, control of hemorrhage, closure of wound, removal of air, application of pressure bandage, and administration of oxygen (thoracoplasty set will be required).

Tension Pneumothorax.—This condition results from a penetrating wound or from an injured bronchus, through which uncontrolled amounts of air escape from the lung into the pleural space. Because this creates a positive intrapleural pressure which causes the lung to collapse, the opening in the bronchial wall acts as a valve and allows air to pass into the pleural cavity but prevents its escape.

Operative Procedure.—Drainage and decompression of the pleural cavity by a closed thoracotomy with underwater-sealed drainage. This procedure reduces the air pressure in the thorax and provides drainage for the blood, the serum, or the purulent material. A closed thoracotomy setup is required.

Hemothorax.—Hemothorax may be produced by an injury to the intercostal vessels, the vessels within the lung, or the major vessels in the mediastinum. When blood accumulates in the thoracic cavity, the increased pressure

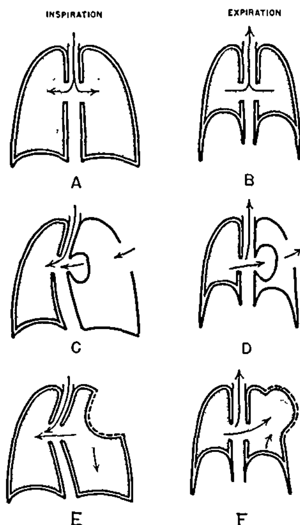


Fig. 237.—Pathologic physiology of severe chest injuries. *A,B,* Normal physiology of inspiration and expiration. *C,D,* Open (sucking) wound of thorax. On inspiration, the air at atmospheric pressure rushes in through the defect (*C*), collapsing the lung. Next, the positive pressure causes the mediastinum to shift, compressing the opposite lung. On expiration (*D*), air from the lung on the uninjured side re-enters the collapsed lung and is rebreathed in the next inspiration. Impaired cardiopulmonary function in the presence of a sucking wound of the chest is due to (1) collapse of the lung on the injured side; (2) partial collapse of the opposite lung; (3) increased functional dead space due to rebreathing of unoxygenated air from the collapsed lung, and (4) diminished venous return to the right side of the heart. *E,F,* Chief effect of paradoxical motion resulting from the "flail or stove-in chest" is a diminution of pulmonary ventilation and extensive rebreathing from one lung to the other. Venous return to the right side of the heart is impaired. Stabilization of the chest wall, either by compression or traction, diminishes the to-and-fro movement ("flutter") of the mediastinum, thus improving the function of the lung on uninjured side. (From Johnson, J., and Kirby, C. K.: Surgery of the Chest, Chicago, 1952, Year Book Publishers, Inc.)

will displace the mediastinum causing circulatory and respiratory problems, as in tension pneumothorax.

Operative Treatment.—(1) Aspiration (thoracentesis) is the procedure of choice; (2) removal of progressive hemorrhage (thoracotomy setup); (3) expansion of a compressed and constricted lung (decortication setup).[5, 12, 19]

Repair of Fractured Ribs and Chest Injuries

Definition.—Internal fixation and approximation of fractured ribs with the aid of suture materials.

Purpose.—To stabilize the chest wall, thereby correcting disturbances in respiratory and circulatory organs within and preventing such complications as *pulmonary abscess, atelectasis, or pneumonia.*

Sterile Setup.—As for thoracotomy, plus bone drill and drill points, bone punch, stainless steel wire, heavy silk, or cotton sutures.

Position, Skin Preparation, and Draping Procedure.—As for chest surgery.

For fracture of the upper ribs, including the anterior to mid-axillary line, a supine position is used; for fracture of the anterior and posterior ribs, involving the sixth to the tenth, a lateral position is used.

Incisions.—The type of incision depends on the ribs which are involved and the location of the fractures. A parascapular incision may be used for posterior fractures of the upper five ribs. For fractures including the sixth rib to the tenth, the incision is made over the affected side. A "U"-shaped incision is used when both the anterior and posterior ribs are fractured.

Operative Procedure.—One of several methods is used. They include an on-end approximation of the fractured ribs by wiring and intramedullary pegging an on-end wiring accompanied by a circumferential wire, or an overlapping of the fragments and wiring.

For fractures of the sternum, the fragments are pushed into proper position and wired together. The fractured cartilages are approximated with silk or stainless steel wire sutures.[16, 19, 26, 35-37]

Therapeutic Artificial Pneumothorax

Definition.—Air is instilled into the pleural cavity, usually through the sixth or seventh intercostal space in the mid-axillary line of the thorax, at periodic intervals.

Indications.—To treat progressive minimal or a slowly indolent lesion of tuberculosis, or to act as a preliminary measure preceding a major lung abscess.

Purposes.—To push the lung away from the inner chest wall in order to cause a collapse of part or all of the lung. This procedure may be repeated until the lesion has healed.

Contraindications.—It is not used to treat extensive bilateral involvement, advanced emphysema, asthma, or purulent exudate which is accompanied by toxic symptoms.

Precautions.—Pleural shock may be caused by trauma to the lung, by air embolism, by *tension pneumothorax, or by the rupture of a superficial cavity.* At the initial injection of air, the patient's head should be lower than the body

to avoid cerebral air embolism. Carbon dioxide or oxygen may be used in place of air as these gases are absorbed more rapidly. Careful aseptic techniques are followed during the procedure.[39-42]

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—The following items should be available:

1 Local set, including syringes, needles, and anesthetic drugs
1 Scalpel handle No. 3 with blade No. 15 or 11
1 Tissue forceps with one and two teeth
1 Tissue forceps without teeth
4 Towel forceps
1 Mayo scissors, curved
1 Needle holder
3 Kelly-Murphy or Rankin hemostats, curved
1 Mayo-Pean hemostat, curved
2 Sponge-holding forceps
2 Davidson or Robinson pneumothorax needles, gauges 18 and 19, short bevel, blunt point
6 Compresses, 3 by 3 inches
2 Sutures, No. 4-0 silk, swaged-on skin needle 3/8-circle, cutting-edge
Skin preparation setup
Minor linen pack
Minor basin set
Gloves
Gowns

Also

Pneumothorax machine with rubber tubing and water manometer

The patient is placed on the operating table, with his affected side uppermost and elevated slightly by a pillow (Chapter 4). The proposed operative site is cleansed and draped with towels. The patient is covered with a sterile sheet, as described for a chest operation.

Operative Procedure.—

1. The prepared site of incision is anesthetized with 1 per cent procaine solution; the skin is punctured with a scalpel.
2. A pneumothorax needle with obturator is inserted into the pleural space.
3. The obturator is withdrawn. The needle is connected to the pneumothorax apparatus which is equipped with a water manometer to determine the centimeters of water pressure. When the reading fluctuates between a negative pressure of —7 to —12, it indicates that the needle has entered a free pleural space If there is a gradual increase in the pressure it may indicate that the needle has penetrated a pulmonary vessel. If there is a moderate fluctuation from a positive to a negative pressure, it indicates that the needle has entered the lung In such conditions the needle is withdrawn and a second needle is inserted.
4. After the characteristic oscillations have been obtained, air is injected. At the initial treatment 300 ml. of air are usually injected, but in pulmonary hemorrhage the amount may be increased. The intrapleural pressure is checked frequently during the injection of air.
5. Since air is slowly absorbed by the pleura, additional injections are given at future intervals of six weeks to three months. The amount of pulmonary collapse is visualized under the fluoroscope or by x-ray pictures.

Closed Intrapleural Pneumonolysis (Division of Adhesions)

Definition.—The introduction of an instrument into the chest wall and the insertion of electrodes for cutting the attenuated web or cordlike bands lying between the parietal and visceral pleura.

Purposes.—To treat isolated adhesions existing between the lung and the chest wall.

Contraindications.—It is not performed in the presence of acute pleurisy with effusion or dense broad adhesions or when a positive pressure exists in the cavity.[23, 43, 44]

Complications and Precautions.—As for thoracic surgery. Postoperative complications which may follow include hemorrhage, pyogenic empyema, bronchopleural fistula, or development of pleural exudate. Aseptic medical standards

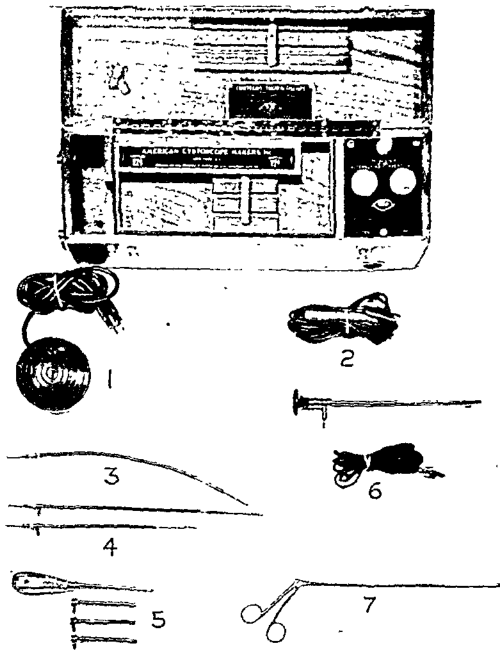


Fig. 238.—Coryllos thoracoscope with cautery and other accessories· *1*, Footswitch, *2*, cable for cautery; *3*, curved cautery and sheath, *4*, straight cauteries with sheaths; *5*, trocar and cannulas for thoracoscope (two plain cannulas and a flexible cannula for cautery); *6*, telescope with cord; *7*, biopsy forceps (From Horsley, G W, and Bigger, I A.: Operative Surgery, vol I, St. Louis, 1953, The C. V. Mosby Co)

must be followed throughout the procedure. The nurse must understand the mechanics of the apparatus to be used and how to sterilize and assemble its parts (Fig. 238). A thoracotomy setup must be available to control an extensive hemorrhage.

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—The items include the following:

1 Local set, including needles, syringes, and anesthetic solution
2 Medication glasses
1 Scalpel handle, No. 3, with two blades, Nos. 15 and 11
2 Tissue forceps with one and two teeth
1 Tissue forceps without teeth
2 Elevators, with sharp hooks
4 Kelly-Murphy or Rankin hemostats, curved
2 Crile hemostats, straight
2 Sponge-holding forceps
4 Towel forceps
2 Skin sutures, nylon No. 5-0 swaged-on needles, 3/8-circle, No. 14
1 Needle holder
1 Thoracoscope with electrodes, cords, and telescope
12 Gauze compresses, 3 by 3 inches
1 Gauze bandage, 2 inches wide
1 Minor linen pack
1 Minor basin set
1 Fenestrated sheet
Gowns
Gloves
Thoracostomy setup (for emergency use)

Other Items

Disinfectant solution and basin for soaking electric instruments (Chapter 2)
Electrosurgical unit
Battery box
Anesthetist's screen
Pillows
Leg strap
2 Sponge-rubber supports
Patient's x-ray films

The patient is placed on the operating table in a lateral position with his affected side uppermost, as previously described. The chest region is elevated slightly by means of pads or by raising the kidney rack so that the affected ribs separate from each other. Pads and pillows are used to stabilize the patient and to provide for proper body alignment.

The proposed operative site is cleansed and the patient draped with a fenestrated sheet, as for chest surgery. (Chapters 3 and 4.)

Operative Procedure.—The following items are used for the various steps:

Steps	*Items*
1. The proposed operative site is anesthetized.	1. Local set, Novocain solution 1 per cent, sponges
2. A small transverse incision is made through the skin and subcutaneous tissue.	2. Scalpel, sponges, Kelly hemostats, suture ligature and scissors
3. A cannula and obturator are inserted into the wound down through the pleura. The obturator is withdrawn and observation telescope inserted. The pleura is examined.	3. Cannula and obturator telescope, cord and battery box

Steps	*Items*
4. The thoracoscope is placed within the tubular portion of the light carrier, which is connected to the battery. The lamp is turned on and the interior of the pleural cavity is inspected.	4. The end of the thoracoscope placed in warm sterile solution to prevent fogging of the inner lens; fogging occurs when the thoracoscope is much colder than the body temperature (air in the pleural cavity)
5. The adhesions are divided. If two or more adhesions exist, the cautery is allowed to cool before the next adhesion is divided. When using a Coryllos instrument, both cautery and thoracoscope are *introduced through the same cannula*, and various approaches can be made without shifting the cannula. (Fig. 238.)	5. Electrosurgical unit, electrodes, Coryllos instrument generally used
6. Instruments are removed, puncture wounds are closed, and firm dressings are applied.	6. Sutures, needle holder, tissue forceps, desired dressing

Open Intrapleural Pneumonolysis

Definition.—Through an interscapular or a high axillary incision and a partial rib resection, an opening , made into the pleural cavity, followed by a division and ligation of adhesions.

Purpose.—To treat broad, isolated adhesions that prevent collapse of the diseased lung, or to treat an incomplete closed pneumonolysis.[25, 41]

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—*As described for thoracic operations. A thoracostomy setup, plus an electro*surgical unit with cutting and coagulation electrodes, is required.

Operative Procedure.—The proposed operative chest region is cleansed, and the patient draped with a fenestrated sheet. The chest is opened as described for thoracostomy.

The adhesions are divided, using the electrosurgical unit. Blood vessels are ligated, and the wound is closed in layers. A firm dressing is applied to prevent the escape of air from the wound.[43, 45]

Pneumoperitoneum

Definition.—The introduction of a pneumothoracoscope into the peritoneal cavity or under both sides of the diaphragm through which air is injected into the cavity or space.

Purposes.—To treat extensive bilateral pulmonary tuberculosis or acute lesions, with or without cavity formation, which involve only a portion of the lung, especially when the risk of pneumothorax or thoracoplasty is contraindicated.

Physiologic Considerations.—In the peritoneal cavity, the pressure tends to equal that of the atmospheric pressure, except in those regions under the dia-

phragm. These regions have a negative pressure which is derived from the pleural cavity.[5, 44, 46]

The injection of air into the upper abdomen changes the subatmospheric pressure to a positive one as an upward pulling force is exerted by the intrapleural negative pressure.[2, 6] The diaphragm rises, and the lung volume is reduced because of the combined traction-and-pull mechanism.

Contraindications.—This procedure is not used to treat a patient with adherent adhesions on the diseased side, with an extensive coronary disease, or with respiratory insufficiency.

Precautions.—As described for thoracic operations. After the air has been injected, the patient may complain of pain in the shoulder, abdominal aching, and tightness in the epigastric region. Care is to be taken throughout the procedure to help prevent a postoperative air embolism, subcutaneous emphysema, or mediastinal emphysema (Fig. 237).

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—As for therapeutic pneumothorax, except a Zavod pneumothorax set is used. The patient is placed on the operating table in a supine position (Chapter 4). The selected abdominal area is cleansed (Chapter 3). The patient is draped as for an abdominal operation (Chapter 4).

Operative Procedure.—One of the following sites is chosen for the injection of air: (1) at a point about 5 cm. to the left of the umbilicus on an imaginary line connecting the left anterior iliac spine with the umbilicus, (2) in the midline below the umbilicus, or (3) below the costal margin near the left nipple line.[46, 47]

Steps	*Items*
1. The operative site is anesthetized. A puncture wound is made in the skin area. (Fig. 226)	1. Local set, including syringes, needles, and 1 per cent procaine solution, sponges, basin for soiled instruments, scalpel
2. The underlying peritoneal cavity or diaphragmatic space is entered and anesthetized. The needle is left in the cavity, and the syringe is removed from the needle's hub. The pneumothorax apparatus is connected to needle. Filtered air, 50 ml., is injected into cavity.	2. Aspirating needle, gauge 19, with short-bevelled point attached to a 2 ml. syringe which is filled with procaine solution; pneumothorax setup
3. After initial injection of air, if the flow is slow and the manometric pressure is positive, it indicates that air has infiltrated the tissue spaces outside the cavity	3. Pressure readings recorded; patient's pulse and respiration rates noted and changes reported to the physician
4. The amount of air injected initially varies between 500 and 800 ml., depending upon the patient's condition. The average amount of maintenance is 1,000 ml. of air per week, but the amount of each injection depends upon size of the cavity, rate of air absorption, and length of time between refills.	
5. The needle is withdrawn, the wound closed, and dressing applied.	5. As for pneumothorax procedure

Operations for Pleural Empyema

General Etiologic Considerations.—Acute empyema may be caused by pyogenic organisms, but generally it is the result of a pneumococci infection with a low fibrin content. In empyema, developing from a lobar pneumonia, the patient's vital capacity may not be greatly diminished since the disease involves only one lung. However, a streptococcal empyema may involve both lungs since it usually accompanies bronchopneumonia.[8, 12, 45, 48, 49]

Putrid or secondary empyema is usually associated with a ruptured lung abscess with or without a tension pneumothorax. Since organisms are usually virulent when drainage is established, special measures must be taken when handling and re-sterilizing soiled equipment after surgery (Chapter 2).

In chronic empyema the pleural membranes become thick and rigid as a result of a prolonged infection. The chest wall becomes rigid and smaller, thus distorting the lungs. The fibrous pleural covering may extend over a part or all of the lung and chest wall. Chronic empyema is the failure of the chest cavity to become obliterated. This condition in turn prevents the unexpanded lung from returning to normal functioning (Fig. 237).

The local causes of chronic empyema may include inadequate drainage of purulent material within the pleural cavity and the presence of such virulent organisms as tubercle bacilli and nontubercular pyogenic types.

Chronic empyema creates additional complications such as mediastinal shift, difficulties in swallowing, deformity of the chest, and respiratory limitations.

Operative Procedures.—One of several operations is carried out to treat empyema. They include (1) thoracoplasty to obliterate the cavity and to collapse the overlying portion of the chest;[8,9,15] (2) pleuropneumonectomy to remove the visceral pleura from the lung in the presence of extensive lesions; and (3) decortication of the lung to eliminate the cavity so that the expanded lung can fill it.[15, 48]

Closed Thoracotomy (Intercostal Drainage)

Definition.—Insertion of a catheter through the intercostal space and the establishment of closed drainage.

Objective.—To restore a negative pressure in the cavity, which is essential to the normal functioning of the respiratory and circulatory system.

Indications.—To provide continuous aspiration of an infectious fluid from the pleural cavity and to avoid an ingress of air at a time when the lung may collapse.

Precautions.—When it is necessary to position a seriously ill patient on the operating table in a sitting position, the thoracic wall may be accidentally punctured, which in turn may cause a cerebral air embolism (Chapter 4).

During the operation, air is prevented from entering the cavity by having the catheter fit snugly, clamping it upon insertion into the cavity, and then attaching the catheter to the drainage set.

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—The following sterile items should be available:

- 1 Local set, including syringes, needles, and procaine solution, 1 per cent
- 2 Sponge-holding forceps
- 1 Scalpel handle No. 3 with blades Nos. 10 and 15
- 2 Tissue forceps with one and two teeth
- 1 Tissue forceps without teeth
- 4 Towel forceps
- 2 Patterson or Davidson trocars and cannulas to fit catheters
- 2 Catheters, desired size
- 1 Catheter, clamp, screw type
- 1 Suture scissors
- 1 Kelly hemostat, straight
- 2 Mayo-Pean hemostats, curved
- 1 Luer-Lok syringe, 30 ml.
- 2 Aspirating needles, gauge 16, 3½ inches
- 2 Skin sutures, swaged-on needle ⅜-circle and nylon or silk No. 4-0
- 1 Minor operating pack, including draping sheet, towels, sponges, and dressings
- 1 Glove set
- 1 Gown set
- 1 Minor basin set
- 2 Culture tubes
- 1 Water-seal drainage set (Fig. 231)
- 1 Fenestrated sheet
- 1 Skin preparation setup

The patient is placed on the operating table in a lateral or semi-reverse Trendelenburg position, as previously described under positioning the patient for chest surgery (Chapter 4). The operative site is cleansed (Chapter 3). The patient is draped with a fenestrated sheet, as for chest surgery (Chapter 4).

Operative Procedure.—The desired items, including a suction apparatus, must be ready for use and in proper working order before the patient enters the operating room.[4, 5, 11, 12, 39]

1. The prepared operative site is anesthetized. An aspirating needle, attached to a syringe, is introduced into the chest cavity to verify presence of pus.
2. The trocar and cannula are introduced through the puncture wound, intercostal space, and then into the pleural cavity.
3. A catheter, desired size, which has been marked for its correct length, is introduced into the cavity immediately after withdrawal of the obturator. The free end of the catheter is clamped to prevent the ingress of air.
4. When the cannula is withdrawn, and a second forceps is placed between the end of the cannula and the patient, the terminal forceps is removed so that the cannula can be slipped off the distal end of the catheter.
5. The skin edges are sutured around the catheter, and the free ends of the suture are tied around the catheter to prevent its accidental withdrawal
6. A dressing is applied to the wound.
7. For continuous drainage without the entrance of air into the pleural cavity, the free end of the catheter is attached to a long rubber tube which is placed beneath the water within the sterile drainage bottle; then the forceps is removed. For continuous aspiration of fluid and the creation of a negative pressure, an underwater-seal drainage set is used (Fig. 234).

Open Thoracotomy (Rib Resection)

Definition.—Partial resection of a selected rib or ribs, usually the ninth in the posterior axillary line, and the establishment of adequate drainage.

Operations for Pleural Empyema

General Etiologic Considerations.—Acute empyema may be caused by pyogenic organisms, but generally it is the result of a pneumococci infection with a low fibrin content. In empyema, developing from a lobar pneumonia, the patient's vital capacity may not be greatly diminished since the disease involves only one lung. However, a streptococcal empyema may involve both lungs since it usually accompanies bronchopneumonia.[8, 12, 45, 48, 49]

Putrid or secondary empyema is usually associated with a ruptured lung abscess with or without a tension pneumothorax. Since organisms are usually virulent when drainage is established, special measures must be taken when handling and re-sterilizing soiled equipment after surgery (Chapter 2).

In chronic empyema the pleural membranes become thick and rigid as a result of a prolonged infection. The chest wall becomes rigid and smaller, thus distorting the lungs. The fibrous pleural covering may extend over a part or all of the lung and chest wall. Chronic empyema is the failure of the chest cavity to become obliterated. This condition in turn prevents the unexpanded lung from returning to normal functioning (Fig. 237).

The local causes of chronic empyema may include inadequate drainage of purulent material within the pleural cavity and the presence of such virulent organisms as tubercle bacilli and nontubercular pyogenic types.

Chronic empyema creates additional complications such as mediastinal shift, difficulties in swallowing, deformity of the chest, and respiratory limitations.

Operative Procedures.—One of several operations is carried out to treat empyema. They include (1) thoracoplasty to obliterate the cavity and to collapse the overlying portion of the chest;[8,9,15] (2) pleuropneumonectomy to remove the visceral pleura from the lung in the presence of extensive lesions; and (3) decortication of the lung to eliminate the cavity so that the expanded lung can fill it.[15, 48]

Closed Thoracotomy (Intercostal Drainage)

Definition.—Insertion of a catheter through the intercostal space and the establishment of closed drainage.

Objective.—To restore a negative pressure in the cavity, which is essential to the normal functioning of the respiratory and circulatory system.

Indications.—To provide continuous aspiration of an infectious fluid from the pleural cavity and to avoid an ingress of air at a time when the lung may collapse.

Precautions.—When it is necessary to position a seriously ill patient on the operating table in a sitting position, the thoracic wall may be accidentally punctured, which in turn may cause a cerebral air embolism (Chapter 4).

During the operation, air is prevented from entering the cavity by having the catheter fit snugly, clamping it upon insertion into the cavity, and then attaching the catheter to the drainage set.

Operative Procedure.—The following items are usually used in performing the thoracotomy:

Steps	*Items*
1. The incision is made over the selected rib and is carried through all tissue layers. The wound edges are protected by towels and pads. Bleeding is controlled.	1. Local setup, if desired, scalpel, tissue forceps, straight hemostats, towels and towel forceps, basin for skin instruments, gauze pads, hemostats, ligatures, scissors
2. The intercostal nerve is blocked. The pleura is aspirated.	2. Procaine solution 1 per cent, needle and syringe; aspirating needle, syringe, and basin
3. The periosteum is incised. The intercostal muscles are freed from the superior and inferior borders of the rib.	3. Scalpel, periosteal elevators, raspatories, rib dissector, scissors
4. The segment of rib or ribs is resected. Bone wax may be applied to the ends of the ribs to help prevent infection and to control bleeding.	4. Bone instruments, including rib shears, cutters, rongeurs, bone wax; gauze pads moistened in saline solution, tissue forceps without teeth, suction set
5. The pleura is incised at the site of the aspiration. The cavity is cleaned.	5. Scalpel, Mayo-Pean straight hemostats, culture tubes, basin for "soiled" instruments
6. For drainage, one or two rubber tubes are inserted through the pleural opening, and the margins of the wound fit snugly.	6. Black rubber tubing with or without lateral openings near end of tube, but long enough to extend a distance into the pleural cavity, long tissue forceps without teeth, Mayo-Pean hemostats

Drainage tubes should be pliable yet stiff enough to remain open in cavity. The diameter of the tube will depend upon the size of the cavity. If lateral holes are made in the tube, it is replaced later by a plain tube. This is done to prevent granulation tissue from growing through the lateral holes and obstructing the tube. The surgeon selects the drainage tube.

Steps	*Items*
7. Suture of chromic gut or silk is passed through one side of tube, through fascia and muscle edge, or through internal periosteum and pleura; then it is tied around the tube.	7. Chromic gut No. 1 or silk No. 1 threaded or swaged-on curved, cutting-edge needle, Hegar needle holders, tissue forceps, scissors
8. Tubes are clamped until connected with drainage bottles.	8. Mayo-Pean hemostats, suction set to evacuate purulent material
9. The intercostal muscles, fascia, and skin are approximated in layers with interrupted sutures.	9. As for thoracoplasty, chromic gut No. 0 and silk No. 4 for skin

Purposes.—To treat secondary empyema lesions and to control aerobic and anaerobic bacteria in the pleural cavity.

Precautions.—As described for a thoracic operation. Since pleural contamination may cause a fatal peritonitis, a clean sterile needle is used for each aspiration. Aseptic techniques are followed during the operation, and the procedure for care of contaminated equipment is followed (Chapter 2).

Setup, Position, Skin Preparation, and Draping Procedure.—The following items should be available:

Local needle set
Procaine solution 1 per cent
Epinephrine, 1 Gtt. to 30 ml., if desired
2 Volkman or Murphy 4-pronged retractors
4 Coryllos, O'Brien, or Sauerbruch retractors, two sizes, suitable to age of patient (Fig. 233)
2 Roux, Farabeuf, or Parker retractors, suitable size
3 Scalpel handles, Nos. 4 and 3; blades Nos. 20 and 10
3 Tissue forceps with 2 and 3 teeth—2, 5½; 1, 7½ inches
3 Tissue forceps without teeth—2, 5½; 1, 7 inches
4 Dissecting scissors, curved—2, 5½ inches; 1, 7 inches; heavy type; 1 straight, 5½ inches
4 Allis forceps, 5 and 6 teeth, 6¼ inches
3 Needle holders, 1 heavy; 2, medium weight
12 Towel forceps
6 Sponge-holding forceps
2 Harrington vulsellum forceps, if desired
12 Crile or Lahey hemostats, straight, 5½ inches
12 Mayo-Pean or Rochester-Pean hemostats, curved, 6¼ inches
2 Ochsner hemostats, straight, 6¼ inches
1 Sauerbruch-Frey or Schneider rib raspatory, or Semb set (Fig 232)
1 Alexander or Overholt periosteotome
1 Doyen rib raspatory, right or left (Fig. 231)
1 Kermisson periosteal raspatory (Fig. 231)
1 Stille-Giertz rib shears, 9¾ inches, or Stille or Gluck rib shears
1 Sauerbruch rib shears, desired size
1 Stille-Luer bone rongeur, curved
1 Sauerbruch or Horsley-Stille bone rongeur, straight (Fig. 231)
2 Syringes, 30 ml.
3 Aspirating needles, gauges 14 and 16, 3½ inches
2 Aspirating suction tubes and suction tubing
1 Stopcock, 2-way
2 Culture tubes
1 Tube bone wax
2 Safety pins
Petrolatum gauze
Silver foil, optional
3 Pieces black rubber tubing, desired diameter and length
1 Wilson button, desired size, optional
1 Catheter, No. 18, 20, 26, or 28 F
Routine major set, including laparotomy sheet, drainage pads, and dressing straps
Chromic and plain gut, Nos. 2-0, 0, and 1
Silk, nylon, or stainless steel wire, fine gauge, for skin closure
Mayo needles No. 3, Murphy No. 2, surgeon's No. 3, and *Keith*, 2½ inches, sutures and swaged-on needles preferred
Routine skin preparation set (Chapter 4)

The patient is placed on the operating table in a lateral position, with affected side uppermost Steps of positioning patient have been discussed previously in this chapter. The proposed operative site is cleansed and the patient draped with sterile sheets as for a chest operation. (Fig. 239.)

Surgical Approaches.—The posterolateral approach is generally used, but the anterolateral approach may be used in some selected cases.

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—Setup as described for thorocostomy, and additional instruments as follows:

2 Stille or Thompson rib shears for dorsal and ventral resection, angular or side-cutting
1 Sauerbruch, Brunner, or Semb shears for cutting all ribs, 10½ inches
1 Shoemaker or Bethune rib shears, adult or child size
2 Sauerbruch or Stille-Luer rib rongeurs—1 straight; 1 curved, desired size
1 Bacon rib shears, for child, if desired
1 Stopcock, 3-way
2 Aspirating needles, gauge 19, 3½ or 4 inches
2 Syringes—1, 20 ml.; 1, 30 ml.

Also

2 Mayo, ½-circle, taper- or trocar-point, No. 4 or 3
2 Surgeon's needles, ⅜-circle, No. 8 or 10
2 Keith abdominal needles, 2½ inches
2 Ferguson, ½-circle, taper-point, No. 8
Chromic gut, Nos. 0, 2-0, and 1
Silk No. 0 and 2-0
Nylon Nos. 4-0 and 3-0
Pneumothorax setup

The patient is placed on the operating table in a lateral position as described previously (Chapter 4). Routine skin preparation is carried out (Chapter 3). The patient is draped with a fenestrated sheet (Chapter 4).

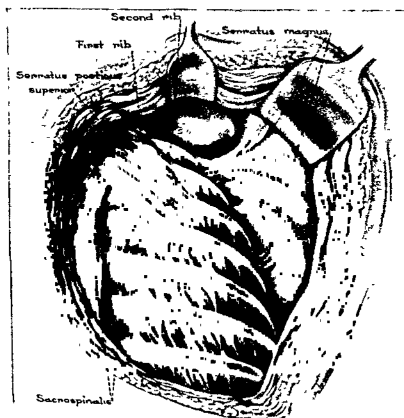


Fig 240—Technique of posterolateral thoracoplasty. The scapula is being retracted posteriorly and laterally, putting the upper portion of the serratus magnus muscle under tension. Muscle attached to second ribs aids in its identification. (From Alexander, J: The Collapse Therapy of Pulmonary Tuberculosis, Charles C Thomas, Publisher.)

Steps	*Items*
10. Dressings are applied over the wound and around tube or tubes. An adhesive strip passed through a safety pin and attached to the tube may be used for fixation of the tubes.	10. Petrolatum gauze may be used around tube and wound edges, 4 by 8 gauze compresses, cotton pad, straps; drainage setup; large safety pin and ½-inch adhesive tape

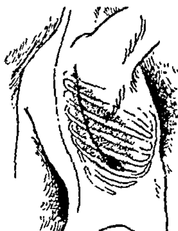


Fig 239 —Incision is made directly over mid-portion of site of lung abscess following the line of underlying rib (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J.)

Extrapleural Thoracoplasty

Definition.—Resection of several ribs. The modern operation of paravertebral extrapleural thoracoplasty is based upon the Wilms-Sauerbruch technique.

Originally, the operation was done in two or three stages and the lower ribs were resected first. In recent years large portions of the upper ribs are removed first, and the shorter segments from the lower ribs are removed in the second or third stages. There is an interval of two or three weeks between the first and second operation. The first stage may include the resection of the complete first two or three ribs. The second stage may include the resection of portions of the next four ribs, and the third stage may include the removal of the tenth and eleventh ribs. The introduction of a chemical such as Zenker's solution or 10 per cent formalin may be used to prevent the regeneration of the ribs during the different stages.

Considerations.—Thoracoplasty is selected for those patients with a productive unilateral fibrocavernous type of pulmonary tuberculosis or when therapeutic pneumothorax and phrenic nerve paralysis have failed to control the disease.[8, 10, 15]

Purpose.—To induce a permanent collapse of the underlying lung, which is maintained by the regeneration of bone from the periosteum of the resected ribs.

Contraindications.—This procedure is not used when the patient's general condition is poor, or in the presence of inadequate respiratory or circulatory reserve, when the tubercle bacilli are in an active stage.

Incision.—The posterolateral incision begins at the midaxillary line, slightly below the level of the scapula, extends posteriorly, curving upward between the scapula and the spine to top of the shoulder, at the level of the first or third posterior vertebras. The incision is usually started at the posterior point. (Figs. 240 and 241.)

Operative Procedure.—The items frequently used in performing a thoracoplasty are listed opposite the various steps.

Steps	*Items*
1. The skin incision is carried down to the muscles. Bleeding vessels are clamped and ligated.	1. Scalpel, compresses, Crile hemostats, Roux or Greene retractors, tissue forceps with teeth, surgical gut plain No. 2-0 or chromic No. 3-0, straight scissors; basin for soiled instruments
2. The wound edges are protected by towels held in place by towel forceps.	2. 2 large skin towels, towel forceps or nylon sutures threated on cutting-edge, 3/8-circle needles, 2 needle holders, 2 tissue forceps, 2 Roux or Richardson retractors
3. The trapezius and rhomboid muscles are elevated and divided. Bleeding vessels are clamped and ligated.	3. Scalpel, sponges on holders, Mayo-Pean hemostats, Ochsner hemostat, suture ligatures or free ties of silk or chromic gut No. 2-0 or 3-0, scissors, laparotomy pads
4. The scapula is separated from the chest wall and retracted; serratus anterior digitations are separated from the ribs.	4. Scapular retractors, desired type; laparotomy pads with rings attached, long scissors, hemostats, long tissue forceps
5. Posteriorly, the insertions of the serratus posterior superior muscle and tendinous insertions of muscles are divided so as to expose neck of each rib. The scapula is retracted upward. The wound is retracted (Fig. 240).	5. Scapula and rib retractors, long curved hemostats, gauze pads, long angulated scissors, long tissue forceps, with and without teeth.
6. Resection of third rib is performed first to facilitate a better approach for resection of second and first rib	
A. Periosteum of rib is incised, freed from rib; intercostal insertions are cut, posterior end of rib freed.	A. Lewis or Alexander periosteal elevator, Berry-Lambert and Schneider rib raspatory, long curved scissors.
A. Tendinous and ligamentous attachments to the rib process are divided, exposing the transverse process of the corresponding vertebras (Fig. 241).	B. Heavy scissors, Harrington vulsellum sequestrum forceps, Lewis elevator.

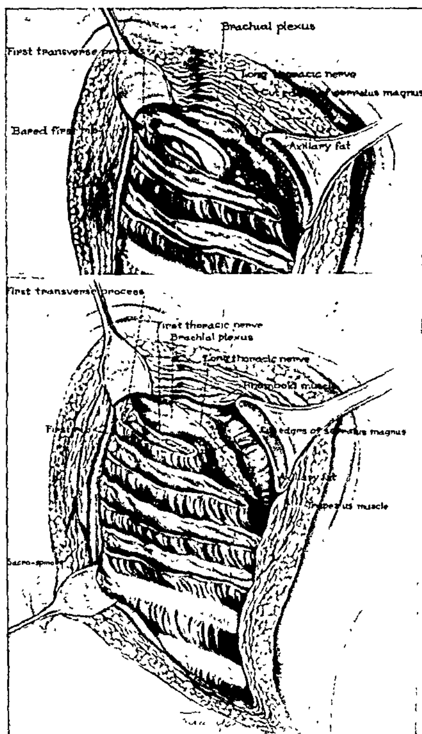


Fig 241 —Technique of posterolateral thoracoplasty—cont'd The origins of the serratus magnus muscle have been separated from the upper five ribs The posterolateral portion of the second and third ribs has been resected and the first rib has been freed of its periosteum. The lower drawing shows removal of the first four ribs completed The entire first rib is resected with cartilage. All of the transverse processes of the vertebras and necks of the ribs, except the first are resected Usually only two, two and a half, or occasionally three ribs are removed at one stage. (From Alexander, J: The Collapse Therapy of Pulmonary Tuberculosis, Charles C Thomas, Publisher)

The anterior stump of the ribs and the first costal cartilage are resected. The wound is closed, as described for extrapleural posterior thoracoplasty.

Posterior Mediastinotomy (Thoracic Approach)

Definition.—Through an incision made in the mediastinum, an abscess in the posterior mediastinum is drained, tumor removed, or esophagus exposed after removal of segments of rib or ribs.[15]

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—A lobectomy setup, plus drains of desired type and size. The patient is placed on the operating table in a lateral position. The proposed operative site is cleansed, and the patient is draped as for a thoracoplasty.

Operative Procedure.—

Steps	*Items*
1 to 7. The chest wall is incised and retracted.	1 to 7. As described for posterior thoracoplasty
8. The pleura is freed from the posterior mediastinum and the wound retracted.	8. Harrington or Reinhoff scissors, long tissue forceps, sponges on holders, long curved hemostats
9. The great blood vessels and intercostal arteries are identified and isolated. Bleeding vessels are ligated.	9. Blunt dissection instruments, sponges, hemostats, silk No. 3-0 ligatures, long tissue forceps without teeth, suction set
10. If the pleura is opened inadvertently, it is closed before an abscess is drained.	10. Interrupted silk sutures No. 3-0 swaged-on needles or Murphy needles No. 3, needle holders, scissors
11. The abscess is aspirated, entered, and drained.	11. Syringe and aspirating needle, sponges on holders, irrigation and suction set, culture tubes, basin for contaminated instruments, Robinson catheter or soft rubber tube
12. The intercostal muscles, rib periosteum, overlying muscles, fascia, and skin are closed in layers. The wound is dressed.	12. As for thoracoplasty

Excision of Tumors in Upper Anterior Mediastinum

Definition.—Through a cervical approach the tumor is removed.

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—The following items should be available; a thyroidectomy setup (Chapter 7), plus periosteal elevators, raspatories, bone-cutting forceps, rongeur forceps, and sternum-cutting forceps to suit the patient.

The patient is prepared on the operating table as described for thyroidectomy, using regular sheets or a fenestrated sheet (Chapter 7).

Operative Procedure.—Similar to posterior mediastinotomy.

Steps	*Items*
C. Ribs are resected, and remaining portions of transverse process and short segment of rib are smoothed off.	C. Rib cutters, rongeur, tissue forceps, scissors, moist pads
D. Bleeding vessels are ligated.	D. Hemostats; silk No. 3-0, scissors, moist pads, moist sponges on holders

7. The second rib, the first rib, the transverse processes of the vertebras, and necks of the ribs, except the first, are resected.

8. All bleeding vessels are controlled by ligation and pressure.	8. Moist pads, saline solution, moist sponges on holders, artery forceps, ligatures, scissors
9. The scapula is pushed back into place. The divided muscles are approximated with two rows of sutures placed in the deep fascial portion of each muscle. The second row is placed in the superficial muscle layer.	9. Sauerbruch, Deaver or Richardson retractors; silk No. 2-0 or chromic gut No. 0, threaded on or swaged-on curved needles, cutting or taper-point; 2 needle holders, tissue forceps, scissors
10. Skin towels and towel forceps are removed from wound edges. The skin area is cleansed. Towels are placed around wound edges.	10. Moist gauze sponges, gauze sponges saturated with alcohol, 4 towels, Greene or Murphy retractors
11. Superficial fascial and subcutaneous tissue layers are closed.	11. Interrupted sutures, cotton or silk No. 3-0 or 2-0, compresses, 2 needle holders, 2 tissue forceps, 2 scissors
12. The skin is closed without drainage. Dressings are applied to the wound and held in place with supports.	12. Cotton or silk No. 4-0, or Dermal No. 4-0 threaded on Keith or Milliner needles, 4 by 8 compresses, dressing support.

Anterior Thoracoplasty

Definition.—Removal of stumps of ribs and their costal cartilages.

Purpose.—To collapse the residual cavities that may remain after extensive posterolateral thoracoplasty.

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—The items include posterior thoracoplasty setup. The patient is placed on the operating table in a supine position, with the arm on the affected side slightly extended and elevated. The elbow is flexed, allowing the forearm to rest near the head. The scapula and arm must be supported by sponge-rubber pads. The body is stabilized by supports (Chapter 4).

The proposed operative site is cleansed (Chapter 3). The patient is draped with a fenestrated sheet (Chapter 4).

Operative Procedure.—A semicircular incision is made along the anterior axillary fold or along the outer margin of the breast. The superficial muscles overlying the thorax are divided and retracted.[8, 12]

Steps	*Items*
6. The thickened fibrous visceral pleura may be removed.	6. As for Step 5

7. The lung is expanded by positive pressure by the closed anesthesia system during the liberation of the lung. The lung assumes its normal relation to the chest, and the negative pressure in the pleural cavity is stabilized by an air-tight wound closure.

8. The raw surfaces on the lung are not closed. Bronchiolar openings may be repaired.	8. Silk No. 3-0 or chromic gut No. 2-0, attached to taper-point, curved needle, long needle holder, fine, long tissue forceps
9. The drainage of serous material in the pleural space and removal of air are accomplished by insertion of catheters which are connected to water-seal drainage.	9. Catheters and hemostats; instruments for stab wound and insertion of catheter; sutures placed around catheter

If two catheters are inserted, the catheter in the upper space removes the air and a second catheter in the lower chest region removes the fluid.

10. The wound is closed in layers.	10. As for thoracoplasty
11. Dressing are applied. Drainage apparatus is connected.	11. 4 by 8 gauze compresses, cotton pads, adhesive strips, drainage set

12. The patient is placed in bed, lying on his affected side. Pillows are used to support his body. The foot of the bed may be elevated twelve inches. Oxygen therapy, infusion, or blood are usually administered immediately.

Segmental Resection of the Lung

Definition.—Removal of individual bronchovascular segments of the pulmonary lobe, the ligation of segmental branches of the pulmonary vein and artery, or a division of the segmental bronchus, followed by closure of the wound and establishment of closed drainage.

Purpose.—To treat a pulmonary tuberculosis and bronchiectasis in order to save the nondiseased portion, or, in some cases, to remove a chronic localized pyogenic lung abscess, to excise congenital cysts, or to remove a benign tumor.[9, 12, 27, 28, 50, 51]

Contraindications.—This operation is not performed in the patient who is suffering from cardiovascular or renal diseases, the elderly patient with bronchiectasis, or the patient with a fever or a history of pneumonitis.

Precautionary Measures.—As for thoracic operations. Postoperative complications may include hemorrhage from the hilar stump, empyema, tension pneumothorax, bronchopleural fistula, pneumonia, atelectasis, or general infection (Fig. 239).

Sterile Setup, Position, Skin Preparation, Draping Procedure, and In-

Decortication of the Lung

Definitions.—Removal of the fibrinous deposit on the pleural lining and closure of a bronchopleural fistula, or removal of a foreign body.

Considerations.—Surgical treatment has been classified as follows:

1. Patients with unexpanded lungs, an arrested infection, and a negative sputum may be treated by thoracoplasty preceding the decortication of the healthy portion of the lung. This procedure leaves the diseased lung untouched, but it prevents the reactivation of the disease.

2. Patients with an unexpanded lung and a positive sputum following therapeutic treatments may be treated by decortication of the healthy portion of the lung, with a resection of the diseased portion.

3. Patients with unabsorbed pleural effusions and an unexpanded lung may be treated by a simple decortication of the lung and drainage of the chest wall.[9, 11]

Purpose.—To treat some tubercular lesions and organized hemothorax.

Sterile Setup, Position, Skin Preparation, Draping Procedure, and Incisional Approach.—As for extrapleural thoracoplasty, adding the following items:

2 Tuttle or Harrington-Mayo thoracic thumb forceps, 9 inches (Fig. 234)
1 Mayo tissue forceps, fenestrated handle, 9 inches, or
1 Nelson lung-dissecting forceps, 6 and 7 teeth, 9 inches
1 Scalpel handle No. 7, blade No. 10
2 Rienhoff or Willauer angular scissors, left and right, 9 inches
6 Rumel, Jones, or Harrington thoracic clamps, slightly curved, angled or full curve (Fig. 233)
Finochietto, Burford-Finochietto, Sweet, or Harken retractors, suitable size (Fig. 232)
Underwater-seal drainage set (Fig. 234)
Asepto syringe, 2 ounces

Operative Procedure.—The items generally used appear opposite the following steps:

Steps	*Items*
1. The incision is carried through skin, superficial fascia, deep fascia, and muscles. The wound edges are protected.	1. As for Thoracoplasty, Steps 1 to 5
2. One rib, usually the sixth, and segments of the fifth and seventh ribs, are resected.	2. As for Thoracoplasty, Steps 6 and 7
3. The parietal adhesions to margins of the lung, the mediastinal surface, and pericardium are divided if necessary.	3. Long curved thoracic scissors and forceps, long hemostats, ligatures silk No. 3, moist sponges on holders
5. The fibrous membrane of the chest wall is incised and peeled away from the visceral pleura, except at point of reflection from visceral to parietal pleura.	5. Blunt and sharp dissection used; angled and curved scissors, thoracic lung tissue forceps, suction set, gauze pads, and saline solution, Asepto syringe

Steps	*Items*
5. The segmental branches of the pulmonary artery are ligated and divided. The bronchus is clamped and divided.	5. Harrington hemostats, Sarot, Rubin, or Harrington bronchus clamps
6. The line of demarcation between segments is determined by inflation. The visceral pleura is completely incised around the diseased segment, beginning at the hilum and progressing toward the periphery. The intersegmental vessels are ligated.	6. Angular, curved scissors, thoracic hemostats, Mayo-Pean hemostats, thoracic tissue forceps; warm saline solution, Asepto syringe, gauze pads and Cameron lights, if desired
7. The segmental bronchus is reamputated and closed with interrupted mattress sutures.	7. Mixter or Rumel clamps, knife or scissors, interrupted silk No. 3-0 or stainless steel No. 5-0, swaged to curved needle, long needle holder, and tissue forceps
8. The raw surfaces of the remaining segments are not closed. The parietal pleura flap may be placed over the bronchial stump.	8. Silk or cotton sutures No. 4-0 swaged-on fine needles, needle holders and tissue forceps

9. The lung is reinflated; bleeding vessels are controlled. The operative field is cleaned. The thoracic wall is examined for ragged bone edges.

10. A catheter is inserted in the pleural space for closed drainage. Stab wound may be made for catheter.	10. Instruments for stab wound opening; catheter, desired type and size
11. The pleural cavity and thorax are closed. (1) For closure of incision by rib resection: The layer-sutures are first passed through the periosteum and subjacent pleura. The ribs are brought together, and the sutures tied. The second row of sutures is inserted. (2) For closure of incision by intercostal technique: Pericostal sutures are passed through intercostal spaces above and below ribs which are separated to relieve the patient of postoperative intercostal pain from nerve pressure. Sutures may be passed through small holes made in adjacent ribs and tied. Rib approximation is accomplished by restoring operating table to a level position, thus eliminating the lateral bend in the thorax.	11. (1) Silk or cotton No. 0 or 1, 18 inches, threaded or swaged to large curved needles, 2 needle holders, straight hemostats, scissors, silk No. 0 or chromic No. 0 for second layer; Lambotte clamp, vulsellum or tissue forceps for bringing ribs together, if desired (2) Chromic gut No. 1, curved trocar-point needles, 2 needle holders, bone punch or drill with No. 6 points for making holes in ribs, chromic gut No. 1 or 2, threaded on large 3/8 curved needles, if desired

cisional Approach.—As for extrapleural thoracoplasty, adding to the setu following:

2 Thoracic tissue forceps without teeth, 9 inches (Fig. 233)
3 Lung forceps, 6 and 9 teeth, 9 and 11 inches (Fig. 233)
1 Scalpel handle, long, with blades Nos. 10 and 15
2 Reinhoff angular scissors, left and right
2 Mayo-Harrington, Nelson, or Willauer scissors, curved, long (Fig. 233)
2 Finochietto or Burford-Finochietto rib retractors, suitable sizes (Fig. 232)
Adson or Harrington retractor with light attached, cord, and rheostat, if desired
4 Harrington vulsellum forceps
2 Duval or Lovelace grasping forceps
6 Rumel hemostats, curved at different angles, or Mayo-Pean curved, 8 inches (Fig. 233)
4 Rochester-Ochsner forceps 1 and 2 teeth, curved, if desired
4 Sarot or Rubin bronchus clamps right or left, long and short jaws with teeth, or Harrington clamp, curved, 11 inches
6 Roberts or Sarot, curved, arter ceps, 8 inches
4 Mixter, O'Shaughnessy, or angled forceps
6 Mayo-Ochsner forceps, straigh inches
2 Masson or Sarot needle ho long
1 Nelson ligature needle, rigl left, 9¾ inches
Cameron lights, straight or an with attachments, if desired
Asepto syringe, 2 ounces
Bone wax
Robinson, Pezzer, or Foley cath desired sizes, No. 20, 22, 24, or
Closed drainage set
Pneumothorax set
Bronchoscopy set
Sutures, silk or cotton, Nos. 4-0 2-0, 1, and chromic gut Nos. 2-0, 0, and 1; plain gut Nos and 0, needles attached to chr Nos. 0 and 2-0 and silk Nos and 2-0, stainless steel No. 5- closure of the bronchus, if des thoracoplasty closure set

Operative Procedure (Modification of the Overholt Technique).—Th tient is placed in a lateral position, with the affected side uppermost. proposed operative site is cleansed and surrounded by towels which ma secured in place or held by towel forceps. The patient is draped with a f trated chest sheet or regular sheets (Chapter 4).

Steps	*Items*
1. The skin is incised; the wound edges are protected, and the chest cavity is retracted, the organs are walled off	1. As described for thoracopl Steps 1 to 5
2. The ribs are widely separated with or without resection.[23]	2. As for thoracoplasty, Steps 6 7, Finochietto-type retrac moist packs
3. The parietal pleura is incised and the adhesions divided.	3. Scalpel, long tissue forceps, racic scissors, curved and ang types
4. The bronchus of the diseased segment is identified. Segmental pulmonary vein is divided and ligated	4. Laparotomy pads, hemostats, atures, Duval forceps, Rume Mayo-Pean hemostats, thor ligature carrier, silk No. 2-0

The lobe is freed and the fissure is opened by blunt and sharp dissection.

The lobe is held by means of a Duval- or Harrington-type lung forceps, and the tourniquet is passed over the lobe and down as far as possible around its hilum which contains the bronchus, the bronchial arteries, pulmonary arteries, veins, and the lymph nodes; then the tourniquet is tightened (Fig. 242).

A second tourniquet may be applied distal to the proximally applied one, or clamps may be used instead of the tourniquet.

The lobe is removed distal to the tourniquets or clamps. The hilar stump is closed by mattress sutures, and the tourniquet is released.

The wound is closed as for segmental resection of the lung.

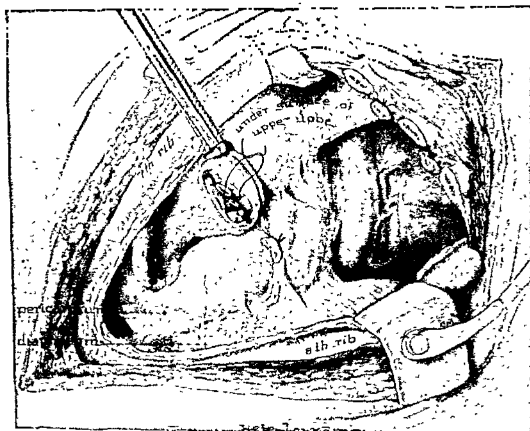


Fig 242.—Lobectomy. Method of closure of pedicle of lobe. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, St Louis, 1953, The C. V. Mosby Co.)

Pneumonectomy

Definition.—Removal of the entire lung.

Purposes.—To treat malignant neoplasms of the lung or an extensive unilateral bronchiectasis involving the greater part of one lung; to drain an extensive chronic pulmonary abscess involving portions of both or all lobes; to remove selected benign tumors; to treat tuberculosis in the main bronchus which has a stricture; or to treat an extensive unilateral lesion (Fig. 243).[12, 15, 16, 22, 54, 57]

Complications and Precautions.—As described for thoracic operations. Postoperative complications in a pneumonectomy are shock, mediastinal flutter,

Steps	*Items*
12. The fascia and subcutaneous layers are closed. Dressings are applied. Closed drainage is started.	12. As for thoracoplasty
13. Mucus and purulent material are removed from the bronchi.	13. Bronchoscopy set and suction apparatus

Lobectomy (Ligation or Modern Technique)

Definition.—Excision of one or more lobes of the lung—left or right upper lobe, middle lobe, or left or right lower lobes.

Purposes.—To treat fibrocavernous tuberculosis, extensive trauma, a chronic lung abscess, a pulmonary cyst, or bronchiectasis involving the greater part of a lobe, to remove an isolated metastatic tumor (especially sarcoma), or to treat certain cases of bronchial adenoma.[11, 15, 16, 52]

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—As described for segmental resection of the lung.

Operative Procedure (Modern Technique).—The following items are generally used in performing a lobectomy:

Steps	*Items*
1 to 5. The chest wall is incised and retracted.	1 to 5. As for thoracoplasty
6. The parietal pleura is incised, then the mediastinal or visceral pleura is incised and dissected free from the hilum of the involved lobe. The branches of the pulmonary artery and vein of the involved lobe are isolated, clamped, ligated, and divided, as for segmental resection of lung.	6. As for Steps 3 to 6 in segmental lobectomy
7. The bronchus is doubly clamped, ligated, and divided. The lobe is removed between clamps. The end of the bronchus is closed.[53]	7. Mattress silk sutures No. 2-0 swaged-on ½-circle, taper-point needles, needle holders, long tissue forceps.
8. The suture line may be covered with the other lobe or with a pleural flap. The wound is closed.	8. As for Steps 9 to 13 in segmental resection of lung

Tourniquet Method.—The tourniquet method of lobectomy is seldom used. However, it may be used in the presence of intense inflammatory reaction within the hilum.

Sterile Setup, Position, Skin Preparation, and Draping Procedure.—As for segmental resection of the lung, plus tourniquets.

Operative Procedure.—The chest cavity is opened as for segmental resection of the lung.

hemorrhage from the pulmonary stump, tension pneumothorax, infection of the pleura and bronchial stump, or reopening of the bronchial stump.

Blood and parenteral fluids must be available.[5, 12, 15] A suction apparatus, a pneumothorax set, a closed drainage set, and the bronchoscopy set should be in the operating room unit before the patient arrives. Suitable suture materials and instruments in proper working order help to decrease the possibility of hemorrhage or the need to reopen the bronchial stump postoperatively. Aseptic methods are carried out to control infection.

Setup, Position, Skin Preparation, and Draping Procedure.—As for segmental resection of a lobe, plus the additional items as follows: 4 Rumel or Mayo-Pean hemostats, curved, 8 inches long.

When a posterolateral approach is to be used, the patient is placed on the operating table in a lateral position; however, in some cases a prone position is used. When an anterior approach is to be used, the patient is placed in a supine position, with the affected arm extended on a support (Chapter 4). The proposed operative site is cleansed (Chapter 3). The patient is draped with a fenestrated sheet or regular sheets (Chapter 4).

Operative Procedure.—The items used for resection of the left or right lung, as shown in Fig. 243, are similar to those used in performing a lobectomy.

Opening of the Chest Cavity.—The chest wall is opened. The pleura is incised, the lung immobilized, and the hilum exposed. The mediastinal pleura is opened. Items as for lobectomy Steps 1 to 6.

Resection of the Left Lung.—

1. The pulmonary artery is freed from the aorta, the pulmonary vein, and a portion of the pericardial sac; then the artery is doubly clamped, ligated, and divided.
2. The pulmonary veins within the pleural cavity are ligated and divided. The vagus nerve may be paralyzed.
3. The bronchus is doubly clamped, ligated, and divided near the tracheal bifurcation. This step may be done before ligation of the pulmonary artery if a posterolateral approach has been used.
4. The bronchial stump is closed with several layers of mattress sutures and covered with mediastinal pleura, as for lobectomy.
5. The mediastinal pleura is closed with interrupted silk sutures No. 2-0 or 3-0 swaged to ¼-circle taper-point needles; then the chest wall is closed in layers.

Resection of Right Lung.—

1. The azygos vein is ligated with silk No. 2-0; then divided between the Ochsner or Mayo-Pean forceps.
2. The superior vena cava and the superior pulmonary vein are identified.
3. The superior pulmonary veins and artery are doubly clamped, ligated, and divided (Fig. 243).
4. The bronchus is clamped, ligated, and divided near the tracheal bifurcation; then the bronchial stump is sutured with several layers of silk mattress sutures, swaged to curved, taper-point needles.

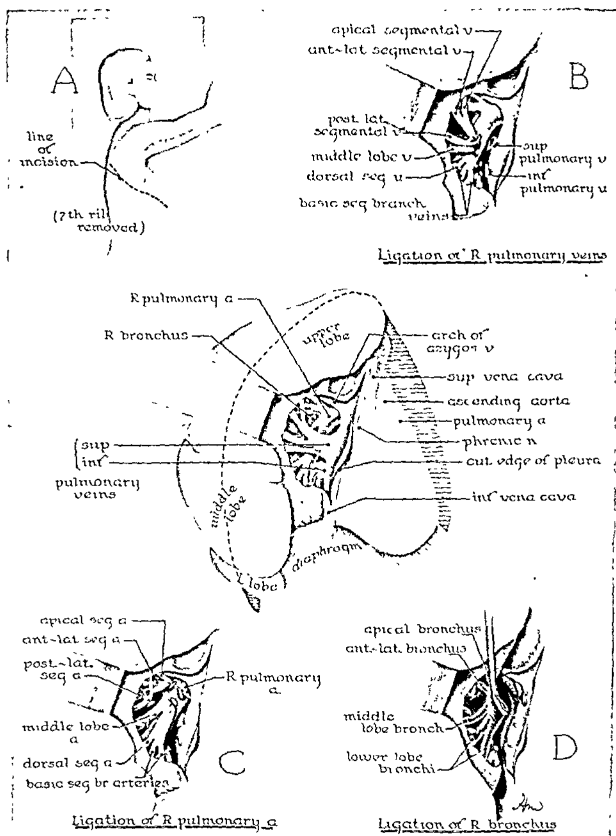


Fig 243.—Hilar anatomy and technique of right pneumonectomy (From Moseley, H. F.: Textbook of Surgery, St Louis, 1956, The C V Mosby Co.)

28. Bugden, W. F.: Pulmonary Resection, Am. J. Nursing 52:38, Jan , 1952.
29. Positioning the Patient for Surgery, Advisory Committee on Operating Room Nursing Films, appointed by A.N A -N L N. Staff Committee on Films, Surgical Film Library, American Cyanamid Co , Danbury, Conn. (Film).
30. Lester, C.: Funnel Chest Allied Deformities of the Thoracic Cage, J. Thoracic Surg. 19:507, 1950
31. Brown, A. L : Pectus Excavatum (Funnel Chest), J. Thoracic Surg. 9:164, 1939.
32. Dorner, R. A , Keil, P. G., and Schissel, D. J.: Pectus Excavatum, J. Thoracic Surg. 20:444, 1950.
33. Mahoney, C. B , and Emerson, G. L.. Surgical Treatment of the Congenital Funnel Chest, J. Thoracic Surg 67:317, 1953.
34. Ravitch, M M : The Operative Treatment of Pectus Excavatum, Ann. Surg. 129:429, 1950.
35. Carter, B N , and Guiseffi, J.: The Use of Tracheotomy in the Treatment of Crushing Injuries of the Chest, Surg Gynec. & Obst. 95:55, 1953.
36. Coleman, F P , and Coleman, C. L.: Fractures of Ribs: A Logical Treatment, Surg Gynec. & Obst. 90:129, 1950
37. Ulin, A., and Rosomoff, H : Airway to Injuries, A M.A. Arch. Surg 67:756, 1953.
38. Churchill, E. D · Architectural Basis of Pulmonary Ventilation, Ann. Surg. 137:1, 1953.
39 Head, J R.: Intracavitary (Monaldi) Suction, J Thoracic Surg. 15:153, 1946
40 Dolley, F. S , Jones, H. C , and Skillen, J.: Extrapleural Pneumothorax, Am. Rev. Tuberc. 41:403, 1940.
41. Ellison, B. M Nursing Care on Collapse Therapy, Am. J. Nursing 50:473, Aug , 1950
42. Head, J R , and Moen, C. W.: Extrapleural Pneumothorax, Am Rev. Tuberc 57:471, 1948.
43. Carter, B. N Intrapleural Pneumonolysis, Am. Rev. Tuberc 24:199, 1931.
44. Jacoboeus, H C : Quoted in Alexander, J. Surgery of Pulmonary Tuberculosis, Philadelphia, 1925, Lea & Febiger, p. 226.
45. Carter, B N · Treatment of Chronic Empyema, Surgery 3:506, 1938.
46 Mayer, R E , Lears, L. H , and Williams, M H.· Pneumoperitoneum, Am J. Nursing 53:332, March, 1953.
47 Banyai, A L : Pneumoperitoneum Treatment, St Louis, 1946, The C. V Mosby Co
48 Brock, R C.· Lung Abscess, Springfield, Ill , 1952, Charles C Thomas, Publisher
49 Brock, R. C : Treatment of Empyema, Thorax 3·88, 1948
50. Chamberlain, J M , and Ryan, T. C : Segmental Resection in Tuberculosis, J. Thoracic Surg. 19:199, 1950
51 Overholt, R H. Segmental Pulmonary Resection, Surgical Film Library, Surgical Products Division, American Cyanamid Co , Danbury, Conn. (Film).
52 Farsie, J H , and Klinger, P. E · Lobectomy for Bronchiectasis, Ann. Surg 137:74, 1953
53 Overholt, R H · Left Lower Lobectomy, Surgical Products Division, American Cyanamid Co , Danbury, Conn (Film)
54 Churchill, E D , and others The Surgical Management of Carcinoma of the Lung, J. Thoracic Surg 20:349, 1950
55 DeBakey, M E , Ochsner, A , and DeCamp, T. P · Primary Carcinoma of the Lung, Surgery 32:877, 1952.

5. The chest wall is closed, with or without drainage, as for segmental lobectomy. The patient is placed in bed (lying on the operated side); the foot of the bed is elevated to aid bronchial drainage; oxygen therapy is administered, and closed drainage (if used) established.

REFERENCES

1. Anthony, C. P: Textbook of Anatomy and Physiology, ed. 4, St Louis, 1955, The C. V Mosby Co, chaps 2, 6.
2. Best, C. H: The Human Body, Its Anatomy and Physiology, ed. 3, New York, 1956, Henry Holt & Co, Inc, chaps. 5, 6.
3. Callander, C L.: Surgical Anatomy, ed. 11, Philadelphia, 1952, W. B. Saunders Co.
4. Comroe, J. H, Jr, and others: The Lung. Clinical Physiology and Pulmonary Function Tests, Chicago, 1955, Year Book Publishers, Inc
5. Johnson, J, and others. Surgery of the Chest, Chicago, Ill, 1952, Year Book Publishers, Inc.
6. Francis, C. C, and Knowlton, G C.: Textbook of Anatomy and Physiology, ed 2, St. Louis, 1950, The C. V. Mosby Co.
7. Schaffer, J. P., Morris' Human Anatomy, ed. 11, New York, 1953, McGraw-Hill Book Co, Inc.
8. Alexander, J: The Collapse Therapy of Pulmonary Tuberculosis, Springfield, Ill, 1937, Charles C Thomas, Publisher.
9. Beecher, H K.. Chest Surgery, Springfield, Ill, 1952, Charles C Thomas, Publisher.
10. Cole, W. H: General Surgery, ed. 6, New York, 1952, Appleton-Century-Crofts, Inc., chap. 30
11. Copper, R.: Diseases of the Chest, ed. 2, Baltimore, 1948, Williams & Wilkins Co.
12. Graham E. A. Lewis' Practice of Surgery, Hagerstown, Md, 1954, W. F. Prior Co, vol. 14, chap 9.
13. Ochsner, A., DeBakey, M. E., and others: Christopher's Minor Surgery, ed. 7, Philadelphia, 1955, W. B Saunders Co, chaps. 11, 12.
14. Stafford, E. S, and Diller, D.: Textbook of Surgery for Nurses, ed. 2, Philadelphia, 1954, W. B Saunders Co
15. Sweet, R. H, and Arroyo, J. R.: Thoracic Surgery, ed 2, Philadelphia, 1954, W. B Saunders Co
16. Moseley, H. F. Textbook of Surgery, St Louis, 1956, The C. V. Mosby Co.
17. King, F. G. Surgical Correction of Funnel Chest, Ann. Surg. 136:789, 1952.
18. Lester, C· Pigeon Breast (Pectus Carination) and Other Protrusion Deformities of the Chest of Developmental Origin, Ann Surg 137:482, 1953.
19. Partipilo, A V: Surgical Technique and Principles of Operative Surgery, Philadelphia, 1953, Lea & Febiger, chap 53
20. Jackson, C, and others Temple University School of Medicine and Hospital· The Bronchopulmonary Segments, Part I Anatomy and Bronchoscopy, Film Library, Pfizer Laboratories, Brooklyn 6, N Y (Film)
21. Overholt, R H, and Langer, L· The Technique of Pulmonary Resection, Springfield, Ill, 1949, Charles C Thomas, Publisher
22. Adams, W E Pneumonectomy for Carcinoma, Surgical Film Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn (Film)
23. Overholt, R H, Woods, F. M, and Ramsey, B H Segmental Pulmonary Resection, J. Thoracic Surg 19:207, 1950
24. Gross, R E· The Surgery of Infancy and Childhood Its Principles and Techniques, Philadelphia, 1953, W B Saunders Co, chaps 2, 57, 58
25. Carter, B. N.: Surgical Management of Chronic "Pneumothorax," J Thoracic Surg 19:167, 1950.
26. Zimmerman, L M, Levine, R, and others Physiologic Principles of Surgery; in Lewis's Practice of Surgery, Hagerstown, Md, 1955, W F Prior Co, chaps 18, 19.
27. Bickford, E, and Budd, E Pulmonary Resection, Am J Nursing 52:40, Jan, 1952.

The right ventricle discharges the venous blood into the lungs by means of the pulmonary artery, which divides into a right and left pulmonary artery. These subdivide and eventually form the capillaries in the lungs. This system is called the lesser or pulmonary circulatory system.

In both the circulatory and pulmonary systems the metabolic blood change occurs only in the capillary beds. Under a controlled pressure mechanism known as the cardiac cycle, oxygen is given off into the tissues and carbon dioxide is taken in by the red blood cells.[1, 4, 7-9] The capillaries empty into the veins, which bring the blood back to the right atrium (Fig. 244). The membranous valves of the heart open and close with the cyclic fluctuations in the blood pressure within the heart chambers. Since the valve action is a passive one, the blood flows in one direction.

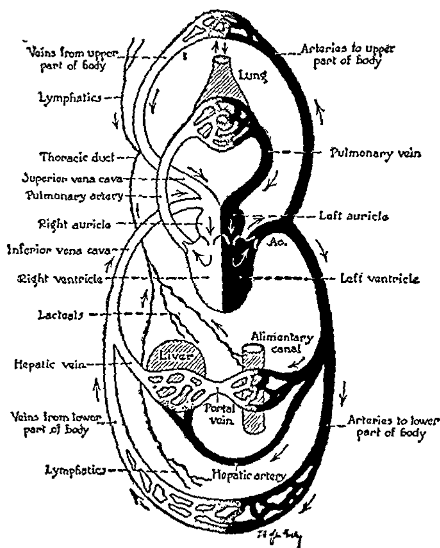


Fig 244.—Diagram of the circulation of the blood. The arterial or oxygenated blood is shown in black, the venous blood in white, and the lymphatics by beaded black lines. The arrows indicate the direction of flow. The two arrows above the lung indicate the interchange of air. The auricle is sometimes used as a synonym for atrium, as in the illustration. (From McClendon, J F.: Physiological Chemistry, St. Louis, 1946, The C. V. Mosby Co.)

CHAPTER 10

CARDIOVASCULAR OPERATIONS

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

The standard textbooks of anatomy and physiology should be consulted for detailed description and function of the circulatory structures.[1-6] Certain facts are presented as they relate to surgical procedures and operating room nursing.

The thymus gland lies in the superior portion of the mediastinum beneath the upper sternum and at the base of the neck, anterior to the ascending aorta and posterior to the left innominate vein. It receives its blood supply from the branches of the internal mammary artery. In a thymectomy, these arteries are dissected and ligated. This two-lobed gland is almost replaced by fibrous and fatty tissue by the time of adult life; its function has not been clearly defined.

The heart, a hollow muscular organ which acts as a power pump for the circulatory system, is enclosed in the pericardial sac forming the lower part of the mediastinum (Chapter 9). The heart lies in the region between the lungs, anterior to the esophagus and to the descending portion of the aorta (Fig. 227). The large blood vessels enter and leave the heart at its base. Two thirds of the heart lie to the left of the midline and the remaining third lies to the right. Surgically, this places the right chambers of the heart in an anterior position; however, it is necessary to make a wide surgical approach to expose a lesion in the left chamber.

The heart wall is composed of three layers: the epicardium, consisting of the inner layer of the pericardium; the muscular or myocardium, which is the important functional layer; and an inner lining, known as the endocardium. The heart is divided into right and left halves. Within a closed system each half contains an upper and a lower communicating chamber. The upper chambers are called the atria (auricles), whereas the lower chambers are called the ventricles. The atria receive the blood. The right atrium has three orifices through which blood enters from the superior and inferior venae cavae and from the coronary sinus The left atrium has four orifices through which the blood enters from the four pulmonary veins, two from each lung. (Figs. 244 to 246.)

The ventricles discharge the blood into the arteries which carry it to all parts of the body. The left ventricle sends the blood through the aorta and its numerous branches, to the head, upper extremities, abdominal organs, and lower extremities. This system is termed the systemic, general, or greater circulatory system.

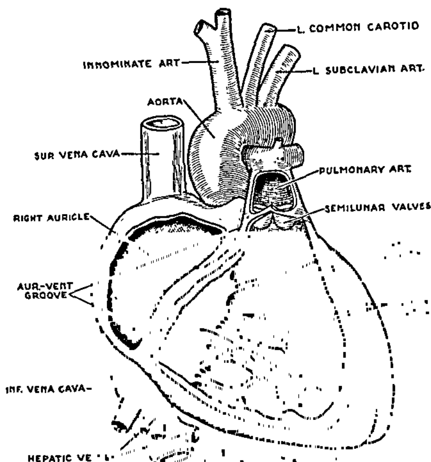


Fig 246—The right auricle and ventricle laid open (After Allen Thompson, from Zoethout, W D, and Tuttle, W. W.: Textbook of Physiology, St Louis, 1950, The C. V Mosby Co)

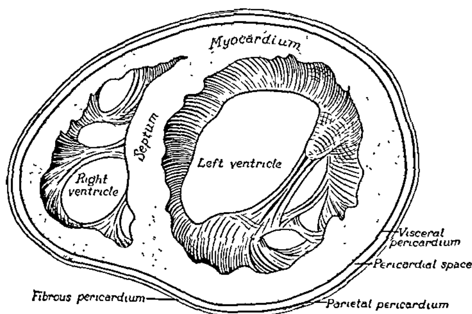


Fig 247—Diagram of a cross-section view of the heart and its coverings, showing the location of the visceral and parietal layers of the serous pericardium, the pericardial space, and the fibrous pericardium (From Anthony, C P Textbook of Anatomy and Physiology, St Louis, 1955, The C V Mosby Co)

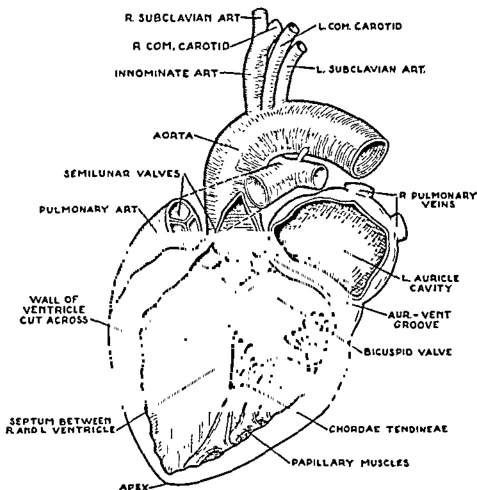


Fig 245—The left auricle and ventricle laid open (After Allen Thompson, from Zoethout, W D, and Tuttle, W. W., Textbook of Physiology, St. Louis, 1950, The C. V. Mosby Co.)

The heart chambers have four valves, two atria ventricular valves and two semilunar valves. The two atrioventricular, termed cuspid valves, guard the openings between the atrium and ventricle of each side of the heart. The right atrioventricular valve, commonly called the tricuspid valve, is composed of several leaflets of endocardium which are attached to the right ventricle by a cordlike structure called chorda tendinae (Fig. 245).

The left atrioventricular valve, usually known as the mitral valve, has only two endocardial leaflets. Its fine cordlike muscles prevent the valve from being turned back into the atrium during the discharge phase of the heart cycle or ventricular systole. These endocardial leaflets allow the blood to flow from the atria into the ventricles, and they also prevent the blood from flowing back into the atria.[10] In normal conditions the ventricular contraction closes the valves by forcing the blood against them, thus preventing the blood from passing into the pulmonary artery and aorta (Fig. 246).

The semilunar valves are situated at the discharge openings of the left and right ventricles. These valves permit the blood to flow forward, and they act in the same manner as the cuspid valves in that they prevent the blood from flowing back into the ventricles from the pulmonary artery and the aorta.

stenosis, however, may occur independently.[9, 14-17] The important symptoms of tetralogy of Fallot are reduced exercise tolerance, retarded growth, possible cerebrovascular accidents, cyanosis, a small heart, low arterial oxygen saturation, and clubbing of the digits.[2, 18]

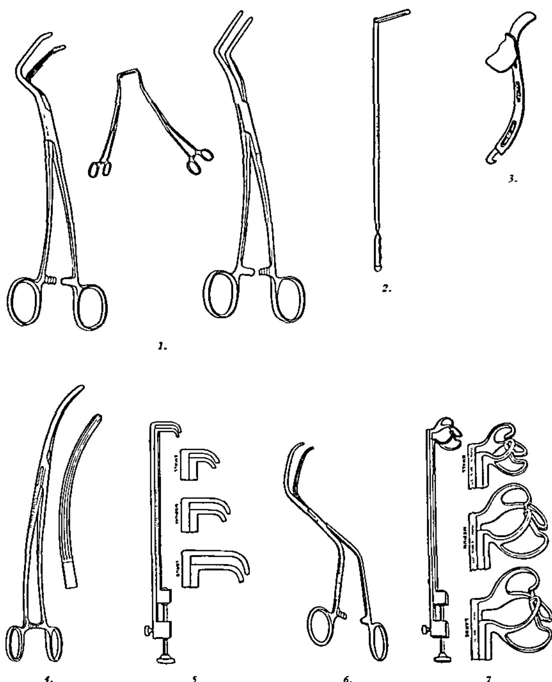


Fig 248.—Cardiovascular instruments *1*, Harken auricle clamps Nos. 1, 2, 3, and 4, constituting a variety of sizes and shapes suitable for operations on auricular appendage (clamps constructed so that one clamp can rest within the other as shown); *2*, Harken valvulotome, available in different sizes, *3*, Bailey-Glover-O'Neil commissurotomy knife, push-type model; *4*, Crafoord coarctation clamp, *5*, Blalock pulmonary artery clamp, available in large, medium, and small sizes; *6*, Satinsky vena cava clamp; *7*, Johns Hopkins modification of Potts clamp, large, medium, and small sizes. Instruments shown are one third actual size. (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

When disease deforms the valves, the leaflets become fibrous and stiff, and their margins swollen, uneven, and adherent to one another. Such abnormalities impair their mechanical function and interfere with the pumping action of the heart. When a valve loses its ability to close tightly, i.e., when there is a valvular insufficiency, the blood may flow back into the part of the heart from which it came, resulting in a condition known as regurgitation.[3, 6, 7, 11] In rheumatic heart disease, the mitral valve frequently becomes narrowed, obstructing the passage of blood from the atrium to the left ventricle, and causing enlargement of the left auricle. The pulmonary valve may be congenitally stenotic. In this condition the right ventricle becomes enlarged.

The myocardium of the heart receives its blood supply from two branches arising from the great aorta, the left and right coronary arteries.[1, 4, 7, 8] Their function is vital in carrying blood to the cardiac muscle cells. If the blood supply is not replenished, the myocardium stops contracting because of the lack of fuel which is needed to furnish the energy, and without contractions of the heart, circulation stops; then death occurs. The middle cervical nerve, composed of sympathetic fibers, and the vagus nerve, composed of parasympathetic fibers, carry nerve impulses to the heart from the medulla (Chapter 6). The sympathetic nerves promote an increase in the force and rate of the heartbeat, and the parasympathetics cause a decrease in rate and force. Since the autonomic and sensory nerves travel together, a patient may feel pain in the inner side of the left arm, when actually the angina pectoris or coronary thrombosis involves the heart.

OPERATIONS

Tetralogy of Fallot and Associated Disorders

Considerations.—The tetralogy of Fallot is the most common congenital cardiac anomaly in the cyanotic group. The cyanosis (dark blue) is the result of an abnormally high amount of unoxygenated blood which is seen in the superficial vessels of the skin. Since there is a low oxygen saturation in these patients, they are usually retarded in growth and activity and may have "clubbed" digits There are several variations which may occur in the tetralogy of Fallot. The essential features of this condition are pulmonary stenosis, overriding of the aorta, high interventricular septal defect, and hypertrophy of the right ventricle These conditions may be subdivided into more complex variations The infundibular stenosis, which is a form of pulmonary stenosis, is the most common in the tetralogy of Fallot. In this type there is a long localized constricture in the pulmonary orifice and the pulmonary conus of the right ventricle. The relative position and size of this muscular band determine the condition of the chamber between it and the pulmonary valve ring.[6, 7, 12, 13]

In pulmonary atresia there may not be a communication between the right ventricle and the pulmonary artery. In a complete pulmonary atresia the patient lives only if the ductus arteriosus remains open or if bronchial arteries supply sufficient collateral circulation of blood. Valvular and infundibular

stenosis, however, may occur independently.[9, 14-17] The important symptoms of tetralogy of Fallot are reduced exercise tolerance, retarded growth, possible cerebrovascular accidents, cyanosis, a small heart, low arterial oxygen saturation, and clubbing of the digits.[2, 18]

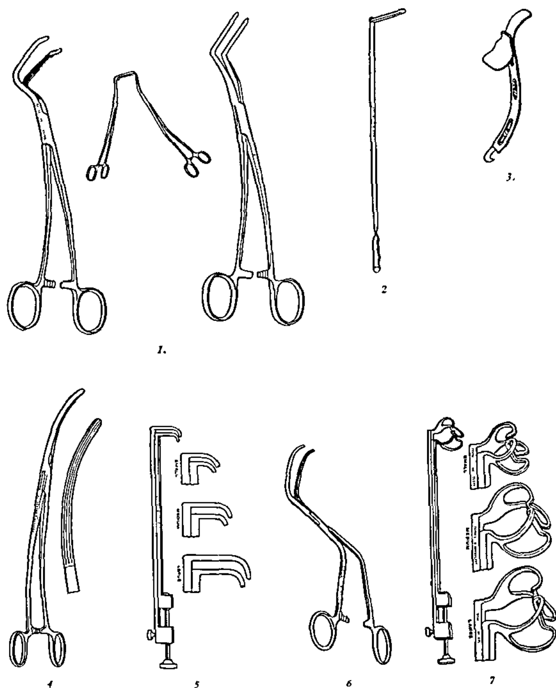


Fig. 248.—Cardiovascular instruments *1*, Harken auricle clamps Nos 1, 2, 3, and 4, constituting a variety of sizes and shapes suitable for operations on auricular appendage (clamps constructed so that one clamp can rest within the other as shown); *2*, Harken valvulotome, available in different sizes; *3*, Bailey-Glover-O'Neil commissurotomy knife, push-type model; *4*, Crafoord coarctation clamp, *5*, Blalock pulmonary artery clamp, available in large, medium, and small sizes, *6*, Satinsky vena cava clamp, *7*, Johns Hopkins modification of Potts clamp, large, medium, and small sizes Instruments shown are one third actual size. (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

The operative plan of treatment depends upon the age of the patient, the presence and size of the pulmonary arteries, and the position of the aortic arch. Such laboratory procedures as angiocardiography and cardiac catheterization may be used in determining the surgical plan of treatment.[12]

Complications and Precautions.—As described for thoracic operations (Chapter 9). Proper positioning of the patient, suitable instruments and sutures, and adherence to aseptic techniques are essential factors to be considered.[7, 9, 19-23]

Purposes.—To divert the blood from one of the major circulatory arteries to one of the pulmonary arteries so that more blood will enter the lungs for oxygenation.

Since the artificial ductus will permit some of the blood that is pumped into the aorta to reach the lungs, the left ventricle will receive more and better oxygenated blood, whereas the right side of the heart will receive relatively less blood.

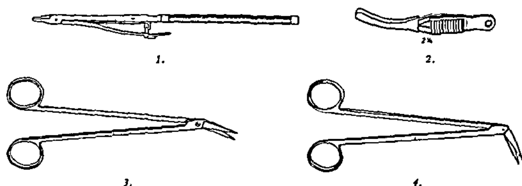


Fig. 249—Cardiovascular instruments—cont'd· *1*, Potts-Smith needle holder, 7 or 8½ inches; *2*, bulldog clamp, available in sizes 1½, 2, 2½, 2¾, 3, and 3½ inches; *3*, Potts-Smith scissors, 60-degree angle, 7½ inches, *4*, Potts-Smith scissors, 30-degree angle, 7½ inches. Instruments shown are one third actual size. (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

Anastomotic Procedures

Definition.—The blood from the aorta is directed into the pulmonary artery through a shunt that is produced by an anastomosis between the arteries as follows. (1) the proximal end of the right or left subclavian artery, the side of the right or left pulmonary artery; (2) the proximal end of the right or left subclavian artery and the end of the right or left pulmonary artery; (3) the proximal end of the carotid or innominate artery and the side or distal end of the right or left pulmonary artery; (4) the side of the aorta and the side of one of the pulmonary arteries to by-pass the stenotic pulmonary valve.[2, 11, 14-17, 19-21, 24 27]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for thoracoplasty (Chapter 9), with instruments and draping sheets of a suitable size for the patient. The additional instruments needed include the following:

12 Crile hemostats, straight, 6¼ inches, according to age of patient
12 to 18 Halsted hemostats, curved, 4¾ inches, for child
12 to 18 Halsted hemostats, straight, 4¾ inches, for child
4 Potts or Gross ductus clamps, fine points

2 Mixter, Mayo-Harrington, or Overholt cystic duct angled clamps
6 Heiss artery forceps, sharply curved, slender, 8 inches; Vanderbilt University vessel forceps; 4 Overholt fine angular hemostats, 6¼ inches
2 Davidson pulmonary vessel clamps, straight, 9 inches, optional
2 Potts-Smith aorta occlusion clamps, 7 inches, for lateral anastomosis, Johns Hopkins modification of Potts clamp, 3 sizes, as desired (Fig. 248)
2 Blalock pulmonary artery clamps, available in 3 sizes (Fig. 248)
4 Potts or Johns Hopkins bulldog clamps, straight and curved
1 Brock knife
1 Potts-Smith or Sweet scissors, 25-degree angle, 60-degree angle, 7½ inches
1 Satinsky scissors
1 Potts-Smith dissecting scissors, 7½ inches
4 Potts-Smith tissue forceps, 7 and 1½ inches
2 Bonney or Potts-Smith tissue forceps, 1 and 2 teeth, 7 inches
2 Harrington-Mayo bayonet or Mayo or Russian tissue thoracic forceps, fenestrated handle, 8, 9, or 10 inches
2 Potts-Smith fine needle holders, suitable length, 7, 8¼, or 9½ inches (Fig. 249)
2 Linton, Lahey, or Smithwick nerve hooks
1 Potts suture hook
1 Caliper
1 Ruler
1 Silver malleable probe
Narrow umbilical tape, optional
Mineral oil and petrolatum mixture for silk sutures, if desired
Procaine solution 1 per cent
10 ml. syringe, needle, gauge 18
Adrenalin solution 1:1,000
Penrose drain, narrow width
Stimulant tray
Thoracoplasty set, plus chromic gut and black silk Nos. 5-0 and 6-0, 18 inches, swaged-on ½-circle taper-point needles

Position and Incisional Approach.—The position of the patient on the operating table is basically supine. Pads of proper dimensions are used to support and stabilize the patient. For some cases a lateral position is used (Chapter 9). The selected procedure must suit the patient's needs and the surgeon's preference. To place a patient in the desired position, the workers endeavor to maintain physiologic functioning, conserve time and energy, prevent bodily harm, and provide for the comfort and dignity of the patient as a person.

The proposed operative site is cleansed (Chapter 3). The prepared area is surrounded by towels, and the patient is draped with small regular sheets or a fenestrated chest sheet (Chapters 4 and 9).

Operative Procedure.—The major items used in the various steps of an operation for tetralogy of Fallot are listed opposite each operative step.

Steps	*Items*
1. The incision is made through the chest wall in the fourth interspace or bed of the fourth rib. The chest cavity is opened and the lung retracted.	1. As described for segmental lobectomy (Chapter 9)
2. The mediastinal pleura is incised and held with traction sutures The incision is enlarged.	2. Scalpel, curved and angled scissors, straight hemostats, silk No. 3-0, 18 inches swaged to needles or threaded on French-eyed needle, needle holders, suction set

Steps	*Items*
3. The vagus nerve may be infiltrated with procaine solution.	3. Procaine 1 per cent, syringe and needle, nerve hook, moist small pack, suction set, tissue forceps
4. The pulmonary artery is dissected free from the surrounding tissue.	4. Curved thoracic scissors and tissue forceps, angled fine-pointed artery hemostats
5. The subclavian artery is exposed and its distal end marked with a silk suture.	5. Blunt and sharp dissection instruments, white or black silk No. 3-0 on swaged-on needle

6a. *Blalock-Taussig Operation.*—Anastomosis is made between the pulmonary artery and the subclavian artery. In dextropositions of the aorta the innominate artery may be used. The anastomosis is positioned (forced) between the cut end of the subclavian artery and the side of the pulmonary artery. The chest wound is closed, and drainage is established. (Fig. 250.)

6b. *The Potts-Smith Operation for Tetralogy of Fallot.*—A direct anastomosis is made between the pulmonary artery and the descending aorta. The greatest length of the pulmonary artery is denuded from its surrounding tissue. The pulmonary artery is temporarily occluded. A portion of the descending aorta is freed and occluded by Potts-Smith or Blalock clamps. The anastomosis is completed between the side of the aorta and the side of the pulmonary artery. The chest wound is closed, and drainage is established. (Fig. 250.)

7. The patient is transported in the stretcher bed to the recovery room by members of the operating team.[8, 9, 11, 26, 30]

Valvulotomy for Pulmonary Stenosis With Intact Interventricular Septum

Definition.—Through an anterior incision in the chest wall and through the left intercostal space, the pulmonary valve is dilated.

Considerations.—The abnormal features of isolated "pure" pulmonic stenosis are usually the result of a deformed pulmonary valve. The cusps, or leaflets of the pulmonary valve are fused into a domelike structure which has a very small opening so that a small stream of blood is ejected through the lungs. If the blood is under high pressure, the pulmonary artery becomes dilated distal to the stenosis Hypertension may be revealed by cardiac catheterization.[13] Frequently there is a foramen ovale or a defect which permits a right-to-left shunt. This in turn causes cyanosis. Myocardial hypertrophy is the result of extra activity of the right ventricle. In patients with a patent auricular defect, if the left side of the heart is overworked, the left ventricle usually becomes hypertrophied[9,13,27 32]

Cyanosis is not always present when the patient is resting, but it appears on exertion and his exercise tolerance is poor. A decrease of exercise tolerance may occur with relatively little cyanosis, but examination reveals heart and liver enlargements.[13] If the stenosis is associated with interatrial defect, the patient has such clinical manifestations as clubbing and a low arterial oxygen saturation.[4] In these cases the shunt operation is not used because it would result in more



Fig 250.—The condition of tetralogy of Fallot is shown. Inset A: The Blalock procedure of anastomosis of the subclavian artery to the right pulmonary artery. Inset B: Potts' operation of direct aortopulmonic anastomosis. (From Moseley, H. F.: Textbook of Surgery, St Louis, 1955, The C. V. Mosby Co)

blood being carried to the lungs which would overload the right side of the heart. Such surgery would also raise the pressure in the left atrium so that less blood would escape from the distended right atrium through the patent foramen ovale.

Purpose.—To increase the pulmonary flow of blood in order to decrease the pressure in the right side of the heart.

Complications and Precautions.—As in thoracic operations (Chapter 9). When the chest is opened the patient's condition may become grave. Hypotension, cardiac arrhythmia, or cardiac arrest may be present. It is important to have stimulants and adequate equipment ready to treat these conditions.[22,23,33-35]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for tetralogy of Fallot. The selected items must be suitable to the age and size

of the patient. The following instruments also should be available:

Chest retractors
24 Halsted hemostats, for child
12 Crile or Hoen hemostats
Brock valvulotomes
Brock dilators or Potts-Riker ad
able valvulotome
Potts-Riker adjustable dilator

Operative Procedure.—

1. A curved submammary incision is usually made beneath the left ni and the chest wall is entered through the third intercostal space; the sec third, and fourth ribs are cut at the costosternal junction.

2. The pericardium is opened and 1 per cent procaine hydrochloride tion may be introduced into the sac and into the wall of the right ventricle.

3. The pulmonary artery is identified and exposed, as in tetralogy of Fa

4. The wall of the right ventricle is mobilized by traction sutures, silk 5-0, swaged-on fine curved needles (Fig. 251).

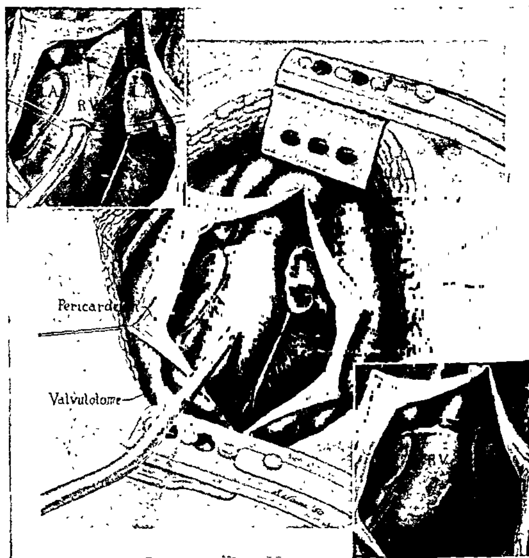


Fig. 251—Pulmonic stenosis—technique for valvulotomy (From Moseley, H. F.: Textbook Surgery, St. Louis, 1955, The C. V. Mosby Co.)

5. The valve is incised with a knife; a closed valvulotome is introduced into the right ventricular chamber directly into the pulmonary artery and then directed into the stenotic pulmonary valve where it is opened. The valve is dilated. The ventricular wall is closed as in the operation for tetralogy of Fallot.

6. The pericardial sac is closed. The chest is drained and the wound closed, as for thoracoplasty (Chapter 9).

Transposition of the Great Arteries

Definitions of Procedures.—(1) Anastomosis of the pulmonary veins to the vena cava; (2) anastomosis of the pulmonary artery to the vena cava; or (3) a creation of an interauricular septal defect, or other similar procedures which are still in an experimental stage (Fig. 252).[2,18,20]



Fig. 252.—Commissurotomy of aortic stenosis. The instrument may be inserted through the left ventricle, as illustrated, or in retrograde fashion through the aorta. (From Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co.)

Consideration.—Complete transposition of the aorta and pulmonary artery is a fairly common anomaly.[2,7,18,36] In this condition the aorta arises from the right ventricle and the pulmonary artery from the left ventricle, thus producing two separate circulations; however, there is some communication between the two sides of the heart or the blood vessels since otherwise, the patient would die.[37] Some of these communications include patent foramen ovale, the interauricular septal defect, patent ductus arteriosus, and partial transposition of the pulmonary veins.[3,9,13,14,38] They allow oxygenated blood to enter the systemic circulation (Chapter 9).

The newborn infant with transposition of the great arteries is cyanotic at birth and severely incapacitated with an enlarged heart involving both ventricles.[15]

Purpose.—To provide a greater admixture of the two circulations.

Setup, Position, Skin Preparation, and Draping Procedure.—The items needed include a setup for opening the chest wall and suitable cardiovascular instruments, such as listed in coarctation and portacaval shunt operations.

Operative Procedure.—The steps of the operation are similar to portacaval or arterial anastomosis procedures described later in this chapter.[5,12,13,19,39]

Commissurotomy for Mitral Stenosis

Definition.—Separation of the stenotic leaflets of the mitral valve.

Considerations.—In an acquired valvular lesion the blood flow is obstructed. This condition provokes a retrogressive rise in the pressure of the pulmonary veins and capillaries. The conelike mitral valve becomes a narrow slit in a fibrotic plaque. Since the heart gives off less blood, the ventricle receives less blood, the blood accumulating in the receiving chamber known as the left atrium.[2, 6, 7, 10, 12, 13, 40-46] This condition, which is known as chronic pulmonary hypertension, increases the pressure in the atrium and causes it to dilate. The blood is transferred backward through the entire pulmonary system, and in the pulmonary capillaries the hydraulic pressure exceeds that of the osmotic pressure of the blood stream. When this happens, the fluid oozes about the capillaries in the alveolar wall and within the alveoli. There is also an increased resistance in the peripheral pulmonary arteries to the blood flow. The patient complains of breathlessness, and pulmonary edema develops.

The major symptoms are dyspnea, restriction in activity, and a cough. When episodes of pulmonary edema and hemophysis occur after either rest or exercise, they signify the presence of pulmonary hypertension. The heart may fail if the pulmonary resistance remains high for long periods of time or the heart muscle is actively decreased by a rheumatic lesion. A chronic heart lesion may be the result of a narrowing in the opening of the mitral valve.[10, 41, 43-47]

Patients with acute rheumatic myocarditis, acute bacterial endocarditis, uncontrollable cardiac failure, or associated aortic valvular disease with left ventricular enlargement are not subjected to this operation.

Postoperative Complications and Precautions.—Embolism, reactivation of rheumatic fever, and infection of the respiratory tract may develop. Operative

precautions as described for thoracic operations (Chapter 9) and for cardiac arrest.[22,23,33-35,40,48,49]

Purposes.—To prolong the life of the patient. The procedure is not a definitive treatment, but lessens the cardiac output and lowers the pulmonary arterial pressure. It does not cure the patient of his rheumatic heart lesion, but relieves the mechanical obstruction and lightens the work of the heart by permitting the deformed leaflets of the valve to open during ventricular diastole and approximate during ventricular systole.[87,88]

Setup, Position, Skin Preparation, and Draping Procedure.—The items should include instruments for opening the chest cavity, as in lobectomy (Chapter 9). Additional instruments include the following:

Stimulant tray
Chest retractors, suitable type and size
2 Satinsky vena cava clamps, or Harken auricle clamps (Fig. 248)
2 Harken, Bailey, or Brock mitral valvulotomy knives (Fig. 248)
1 Frazier, Potts, or Adson dura hook
1 Lillie or Harrington scissors, blunt-pointed, curved blades
2 Mucosal tissue forceps
24 Hemostats, straight, fine points, 4¾ inches
3 Catheters, Foley, Pezzer, or Robinson, No. 22, 26, or 28 F
4 Penrose drains, ¼-inch diameter, if desired
Procaine solution 4 per cent
Syringe and needles, or sterile throat spray
Sutures as for tetralogy of Fallot operation

The patient is placed in a supine or a lateral position (Chapters 4 and 9). The proposed operative site is cleansed (Chapter 3). The patient is draped with a fenestrated sheet or small-sized regular sheets.

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1-6. A left posterolateral or a curved linear incision is made through the chest wall and through the fourth or fifth intercostal space. A portion of the fifth rib may be removed. The lung is collapsed.[40-46]	1-6. *As for thoracoplasty*
7. The innominate, common carotid, and left subclavian arteries are mobilized by traction, using Penrose drains, if desired.	
8. The pericardium is incised, the flaps are grasped, and the pericardial sac may be sprayed with procaine solution.	8. Scissors, fine tissue forceps, small moist packs, long dressing forceps, fine-pointed hemostatic forceps, arterial silk sutures, procaine solution 4 per cent in a spray or syringe with needle.
9. A heavy silk purse-string suture is passed around the base of the left auricular appendages as a traction suture. A clamp is applied distal to the suture to prevent leakage. Tip of the auricle appendage is cut so that heart can be entered.	9. Duval clamp, white or black silk, No. 0, Harken or Satinsky clamps, Harrington scissors, long tissue forceps, sponges; fine hemostatic forceps

10a. *The Manual Method.*—The purse-string suture is held as the clamp is opened. The surgeon introduces a finger into the chamber of the left auricle. Bleeding is controlled by tightening the purse-string around the surgeon's finger or if Penrose drains are used, traction is applied to them. The valve is explored; the calcified leaflets are fractured by finger pressure. The finger is withdrawn, the purse-string is tightened and tied, and the clamp is removed.

10b. *The Instrument Method.*—The surgeon puts on an extra glove which is minus the tip of the first finger. A small opening is made in the palm of the glove. The mitral knife is passed through the opening out between the two layers of the glove to the tip of the first finger. The surgeon inserts *the gloved finger with knife into the left auricle as the clamp is removed;* then the stenotic valve is explored and cut. (Fig. 253.)

The Harken or Brock mitral knife slides back and forth in the ring that is attached to the operator's finger, the tip of which is used to direct the cutting edge against the margin of the valve.

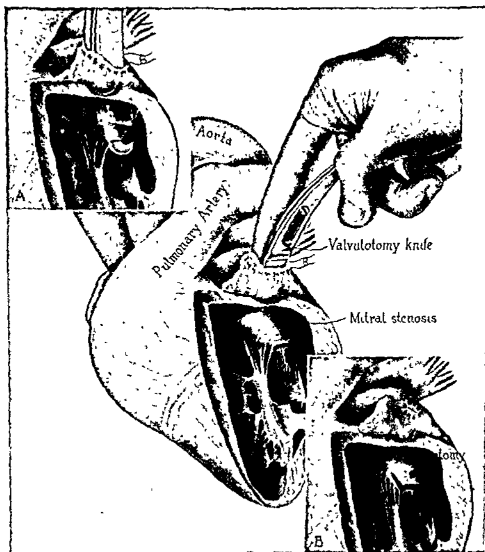


Fig. 253.—The technique for mitral commissurotomy is shown (From Moseley, H. F· Textbook of Surgery St Louis, 1955, The C V Mosby Co.)

Steps	*Items*
11. The auricular opening is reinforced with mattress silk sutures; all bleeding is controlled; then the pericardial edges are approximated loosely to permit drainage.	11. Arterial silk sutures and swaged-on needles, mucosal tissue forceps, curved scissors, needle holders
12. The pleural cavity is drained. The tube may be brought through a stab wound in the intercostal space. The chest wall is closed in layers and dressings are applied. Closed drainage is established.	12. Catheter, desired type and size, knife, tissue forceps, scissors, sutures as for thoracoplasty, dressings, drainage bottles (Fig. 237)

Patent Ductus Arteriosus in Children

Definition.—Closure of the patent ductus arteriosus by ligation or by division of the divided ends of the ductus.

Considerations.—The patent ductus arteriosus is an important fetal vascular communication whereby blood is shunted in intrauterine life from the pulmonary artery into the aorta.[2, 6, 7, 9, 12, 13] During fetal life the lungs are inactive and the blood is oxygenated in the placenta. Normally, the pressures in the systemic and pulmonary arterial circulations become equalized soon after birth, and the blood ceases to flow through the ductus. (Fig. 255.)

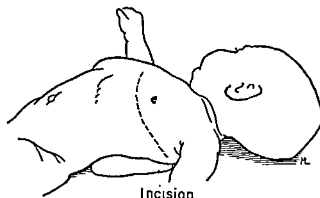


Fig. 254.—The anterolateral incision used in operation for closure of patent ductus arteriosus. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, vol. I, St. Louis, 1953, The C. V. Mosby Co.)

When the ductus arteriosus remains patent after birth, it usually becomes an isolated defect, which increases the work of the heart, and is detrimental to the health. Persistent patency of the ductus, when it is associated with other malformations of the cardiovascular system, such as tetralogy of Fallot and extreme stenosis of the pulmonary orifice, serves as a means of maintaining life in the patient. In some patients with transposition of the great arterial trunks, the ductus arteriosus may carry blood to the lungs.[51]

Patent ductus is more common in girls than in boys; but many children have few symptoms because of the small size of the shunt. The clinical sign associated with this disease is a harsh continuous murmur. Since the venous blood does not escape into the systemic circulation and the blood is oxygenated, there is no cyanosis, clubbing, or reduction in peripheral arterial oxygen saturation. Growth is retarded in children who have a large ductus. Clinical signs such as dyspnea, palpitation, and limited exercise tolerance are also associated with cardiac enlargement.[52, 53]

Surgery is not performed if the patent ductus is serving in a compensatory capacity.

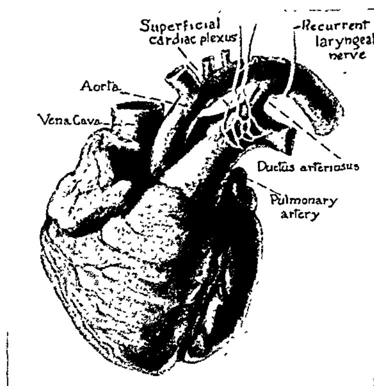


Fig 255.—Drawing of a heart and great vessels from a 4-week-old child, showing position of the ductus arteriosus and its communications with pulmonary artery and aorta (From Gross, R E: Ann Surg, Sept, 1939.)

Purpose.—To interrupt the flow of blood through the patent ductus so that the strain can be removed from the left ventricle.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for tetralogy of Fallot and for preparation of the patient for chest surgery (Chapter 9). Potts ductus clamps are required. Usually a left anterolateral incision is preferred, and the patient is placed on the operating table in a supine position, with the left arm extended slightly forward and the left shoulder and costal region elevated (Chapter 4).[9, 37] When a left posterolateral incision is to be made, a right lateral position is used (Chapter 9).

Operative Procedure.—The items used in an operation for patent ductus include the following:

Steps	*Items*
1. The incision is carried through the muscles overlying the chest. The chest wall is entered through the third or fourth intercostal space. Wound edges are protected and retracted. The fourth rib may be resected.[47,51-58]	1. As for thoracoplasty — Finochietto, Tuffier, Harken, Davidson, Coryllos, or Sauerbruch retractors required, sizes suitable to patient
2. An incision is made through the pleura, extending to the hilus of the lung. The left lung is collapsed and protected with moist packs; then retracted (Fig. 254.)	2 Knife, long curved scissors, suction set, moist packs, hemostats, thoracic forceps, syringe with needle, procaine solution
3. The mediastinal pleura is opened between the phrenic and vagus nerves over the region of the ductus. The laryngeal nerve is exposed; the aortic arch and pulmonary artery are dissected free. Pulmonary arterial branches are divided and ligated.	3. Knife, angular scissors, thoracic aneurysm carrier, angular-jawed hemostats and forceps, silk No. 3-0, vein hook, ligatures or sutures of silk swaged to needles, needle holders
4. The pericardial membrane overlying the ductus is dissected free and retracted	4. Potts-Smith tissue forceps, Potts-Smith scissors, or Satinsky scissors, silk No. 5-0 or 4-0 swaged to needles, Potts-Smith needle holder, straight Halsted hemostats

5. The adventitial layer of the ductus is dissected free; the posterior section of the ductus is freed blindly by using a clamp—and then retracted. The aortic and pulmonary portions are completely dissected.

6a *The* [illegible] *lock* [illegible] or [illegible] placed around the vessel, near the aorta (Fig. 256).[53]	6a. Harken, Gross, or Crafoord clamps, silk No. 0 or 2-0, umbilical tape, hemostats
6b. *Division of Ductus (Gross and Potts Technique)* — The traction tapes are removed and replaced by narrow, curved, closed clamps; the angled ductus clamps are applied near the aorta and the straight type near the pulmonic side; the ductus is incised and then severed.[52, 55, 57]	6b. Harrington scissors, aorta clamps, straight and angled clamps, Potts modification, or Gross clamps, Potts-Smith scissors

The aortic and pulmonary side of the ductus are sutured with a continuous double row of arterial silk sutures No 5-0, using a Potts or Bonney tissue forceps and a Potts-Smith or Gross needle holder.

Steps	*Items*
7. The mediastinal pleura is closed with interrupted silk sutures No. 3-0 swaged to needles. Penicillin may be injected over the aortic and pulmonic sutures. The lung is re-expanded, and the chest cavity is drained by a catheter and closed drainage (Chapter 9).	
8. The chest wall is closed in layers and dressings are applied.[8]	8. As for pneumonectomy (Chapter 9)

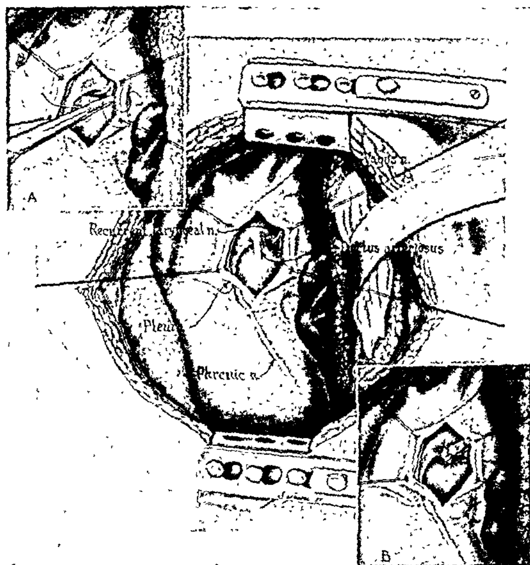


Fig 256 —Patent ductus arteriosus *A* and *B* demonstrate division and ligation of ductus (From Moseley, H F. Textbook of Surgery, St Louis, 1955, The C. V. Mosby Co)

Coarctation of the Aorta

Definition.—Through a posterolateral incision of the chest wall, with removal of the left fifth rib, the segments of the aortic arch or a portion of the thoracic aorta are divided, and the proximal and distal segments are joined together.

Considerations.—Coarctation of the aorta narrows or constricts the aorta, especially its inner layer. The lesion may be classified as a complicated or uncomplicated type of coarctation.[59-66] The complicated type consists of a long constriction, usually in the aortic arch proximal to the junction of the aorta and ductus arteriosus.[63] The ductus usually remains patent and is associated with other cardiac defects. In adults, the uncomplicated type of coarctation of the aorta consists of a constricted area at or just distal to its junction with the ductus arteriosus, which is generally closed.[2] The constriction is usually localized. This type is compatible with life for a considerable period of time.

The cause of coarctation of the aorta is unknown. The patient with uncomplicated coarctation complains of hypertension. The lesion may be discovered incidentally or because of its associated symptoms. Dyspnea, palpitation, vertigo, headache, throbbing in the head, visual troubles, and weakness are common symptoms. When the aorta is almost obstructed, the patient suffers from hypertension in the upper part of the body, and a low blood pressure, hypotension, in the lower extremities. This condition and other symptoms force the patient to seek medical advice. In hypertension, nature intervenes by enlarging the collateral blood supply and joining the channels which unite with the blood vessels of the shoulder, the upper extremities, and the lower extremities. By so doing, the intercostal vessels which pass parallel to the ribs dilate, allowing their branches to carry blood from the subclavian arteries downward; however, occasionally, the vessels erode the lower margins of the ribs. The life of a patient with the uncomplicated type of coarctation is usually shortened, but a successful correction renders him functionally normal.

Age is not considered a contraindication to operation, but those patients over 30 years of age are not treated unless the symptoms warrant the increased risk. The best results are obtained when surgery is done after the aorta has reached its normal adult size. The most satisfactory results are obtained in patients between 8 and 15 years of age.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for operations to treat tetralogy of Fallot. The Potts or Crafoord occlusion clamps or their modifications also are required (Fig. 248). The patient is placed on the operating table in a slight lateral position, with the left side uppermost. The operative site is cleansed (Chapter 3). The patient is draped with small sheets or a fenestrated sheet (Chapters 4 and 9).

Operative Procedure.—The steps, as shown in Fig. 257, and items include the following:

Steps	*Items*
1-6. A left posterolateral incision is carried through the chest wall. A rib resection is carried out. Bleeding is controlled. The mediastinal pleura is incised over the constricted portion of the aorta.[67]	1-6. As for thoracotomy: chest retractors of suitable size, Mayo-Pean and Crile hemostats, ligatures of chromic gut No. 2-0, scissors, moist packs, dressing forceps, scalpel, scissors, suction set, pads

Steps	*Items*
7. The aorta is elevated, the intercostal arteries are dissected free, and some are ligated. The ductus arteriosus is ligated and divided.	7. Long curved and angled blade scissors, long knife, long forceps, rubber-shod clamps, chromic gut, No. 0 or 2-0 or silk No. 2-0, heavy silk ligatures No. 0 or 2-0
8. The upper and lower ends of the aorta are placed under traction; then the clamps are applied and the constricted segment is divided between the clamps. Bleeding is lavaged and suctioned away. (Fig. 257.)	8. Sharp and blunt dissection instruments, blunt hooks, tape, intestinal rubber-shod forceps, Potts clamps, coarctation clamps, moist pads, suction set, Asepto syringe, saline solution, silk ligatures

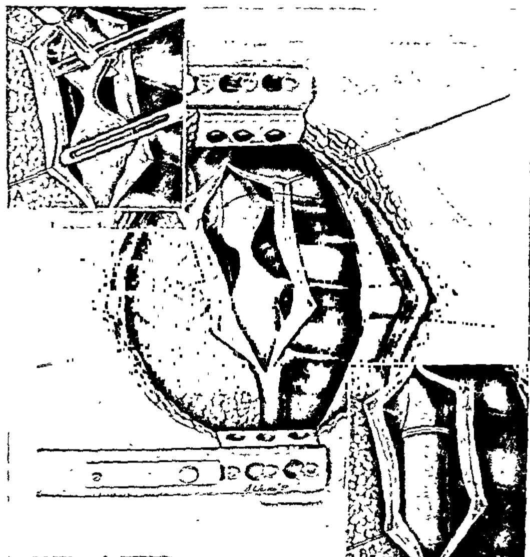


Fig. 257.—The location of the coarctation of the aorta in the mediastinal space is shown Insets: Technique of resection (From Moseley, H. F. Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co.)

Steps	*Items*
9. An end-to-end anastomosis is performed, or if the stricture is long, a homograft or prosthesis is used to bridge the defect.	9. Arterial silk No. 5-0 or 6-0 as in tetralogy of Fallot operation; sutures, clamps, or prosthesis, examined before handing them to the surgeon
10. The parietal pleura is closed over the aorta. Closed drainage is established and the chest wall is closed in layers. The wound is dressed.	10. Silk No. 4-0 swaged-on needle, and sutures for closure of chest wall as for lobectomy; dressings

Pericardiectomy

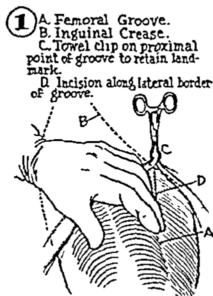
Definition.—Removal of the visceral pericardium of the heart.

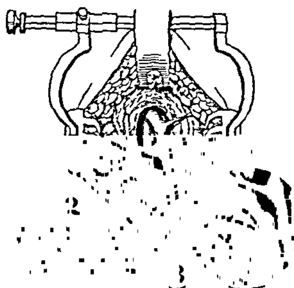
Purpose.—To relieve chronic fibrous thickening of the pericardium that results from tuberculosis or chronic pericarditis.[4, 19]

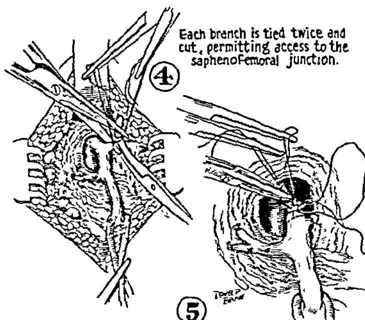
Setup, Position, Skin Preparation, and Draping Procedure.—As for decortication of the lung (Chapter 9). The patient is placed on the operating table in an anterolateral position, basically the same as supine. Pads are used to support the unaffected side (Chapter 4). The proposed operative site is cleansed and the patient draped with a fenestrated sheet (Chapters 3, 4, and 9).

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1-6. A curved incision is made in the chest wall, extending from the second interspace downward over the midline of the sternum and out to the sixth costal cartilage, or a straight incision is made in the fifth rib.[2]	1-6 As for lobectomy (Chapter 9); suction set connected, tested, and then turned off until needed
7. The pericardium is opened.	7. Long fine dissecting scissors, forceps, hemostats
8. The visceral pericardium is dissected away from the left and right ventricles.	8. Dissecting scissors, laparotomy pads, hemostats, sponges on holders
9 The pericardium is closed.	9. Interrupted silk sutures No. 4-0
10 Drainage is established between the pericardium and pleura.	10. Scissors, hemostats, desired drainage tube or catheter
11. The wound is closed in layers	11. As for lobectomy
12. Dressings are applied	12. 4 by 8 compresses, adhesive strips







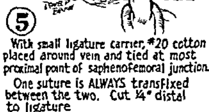


Fig 258.—Operative procedure for saphenofemoral ligation. *1*, Palpation of the femoral groove distal to the inguinal crease to locate the site for the vertical incision and the exposure of the fossa ovalis and saphenofemoral junction; *2-5*, operation and suture. (From Theis, F. V., and Helmen, R. T.: S. Clin North America 35:285, 1955.)

High Ligation of Saphenous Veins

Definition.–Ligation and division of the saphenous trunk situated in the groin region of one or both sides.

Considerations.–A series of cup-shaped valves maintain the blood flow in the veins in a direction toward the heart.[36, 68] When normal functioning of these valves is disturbed due to disease, distention, or back pressure on the veins, the veins gradually dilate, especially those in the lower extremities. The dilatation of the saphenous vein produces venous stasis, with secondary complications following.[36, 50, 68-74]

Purpose.–To remove the diseased veins, thus preventing ulceration, secondary edema, pain, and fatigue in the extremity.[73, 75]

Setup, Position, Skin Preparation, and Draping Procedure.–The items include the following:

Minor operating pack
Minor basin set
Saphenous vein sheets
Gown set
Glove set
Minor dissecting setup, plus
1 Weitlaner self-retaining retractor
2 Metzenbaum scissors
1 Injection set, including syringe, needle, file, and medication
1 Local set, including 2 syringes, needles, graduate, and anesthetic drug
Desired supports for legs

The patient is placed on the operating table in a supine position, with the legs slightly abducted (Chapter 4). The feet may be supported on a padded rest that has been placed previously across the lower part of the table. The legs are stabilized and secured by means of small pads and a gauze bandage. The perineal region is covered with a small towel. The legs and groin region are exposed, and the upper part of the body is covered with a sheet or gown. The arms are secured at the sides in the flaps of a lift sheet.

The skin area is cleansed (Chapter 3). The patient is draped with towels and a fenestrated sheet or regular sheets (Chapter 4).

Operative Procedure.–The steps, as shown in Fig. 258, and items include the following:

Steps	*Items*
1. An incision about 2 inches long is usually made parallel to the crease in the groin. Bleeding vessels are clamped and ligated.[19,73]	1. Scalpel, tissue forceps, gauze sponges, Crile hemostat, ligatures, plain No. 3-0 or silk No. 4-0, scissors
2. The underlying subcutaneous tissue and fascia are incised.	2. 2 Tissue forceps, scalpel, sponges
3. The saphenous vein is identified and isolated. Margins of the wound are retracted.[70,74]	3. McBurney, Mayo, or Collins retractors or self-retaining retractor, peanut sponges on holders, Metzenbaum scissors, Babcock forceps or Mayo-Pean hemostat

Steps	*Items*
4. The saphenous vein and branches are doubly ligated or transfixed, clamped, and divided.	4. Surgical gut, chromic, or plain No. 2-0, 0, or 1 or silk No. 3-0 or 2-0, Mayo-Pean hemostats, scissors, transfixion suture threaded on Murphy needle No. 3 on needle holder
5. The proximal stump is dissected upward to the point where it enters the femoral vein where it is carefully religated. The distal stump may be injected with a sclerosing solution. The varicose veins may be ligated.	5. Curved Metzenbaum scissors, small hemostats, suture ligature. 15 ml. Luer-Lok syringe; 1 intravenous needle, gauge 20, 1½ inches, dissecting instruments
6. The fascia and subcutaneous tissue are closed.	6. Interrupted sutures, plain No. 0 or chromic No. 2-0. Silk No. 3-0 threaded on Murphy needle No. 3, tissue forceps, scissors
7. The skin edges are approximated Dressings are applied to the wound surfaces.	7. Skin hooks, tissue forceps, silk No. 4-0 threaded on Keith needles

Excision of Saphenous Veins

Definition.—Ligation and excision of saphenous veins.

Purpose.—To treat extensive varicosities of the lower extremities.

Setup, Position, Skin Preparation, and Draping Procedure.—As for saphenous vein ligation, plus additional Kelly or Crile hemostats, and vein strippers, preferred type, and orthopedic draping pack for a leg (Fig. 259).

The patient is placed in a supine or semilateral position, with affected leg *slightly abducted, knee flexed, and leg and foot supported. The entire leg and* groin region are cleansed in the routine manner (Chapters 3 and 17). The patient is draped with sheets as for an operation on the leg (Chapter 17).[13, 68, 76]

Operative Procedure.—The steps, as shown in Figs. 258 and 259, and items include the following:

Steps	*Items*
1. The incision is made in the upper thigh, parallel to the crease in the groin Bleeding vessels are clamped and ligated	1. Knife, tissue forceps, gauze sponges, Crile hemostats, ligatures, surgical gut plain No. 3-0 or silk No 4-0, straight scissors
2 The saphenous vein is exposed and ligated.	2. Procedure as for high ligation of saphenous vein
3 The distal end of the saphenous vein is threaded on the stripper. The stripper is pushed downward to a point near the knee	3. Mayo or Babcock vein stripper, thumb forceps, Mayo-Pean hemostat, small sponges on holders
4. A second small incision is made at a point near the knee (Fig 259)	4. Knife, tissue forceps, Crile hemostats, ligatures, small retractor, if necessary

Steps	*Items*
5. The vein is delivered and doubly ligated or transfixed.	5. Crile or Allis hemostat, surgical gut, chromic No. 0 or plain No. 1 or silk No. 1 or 0 ligatures threaded on Murphy needle No. 3, tissue forceps, scissors

6. Stripping of other veins of the extremity may be carried out through small incisions in the same manner.

7. The fascia and the subcutaneous tissues are closed.	7. Interrupted sutures, surgical gut, plain or chromic No. 2-0 or silk No. 4-0, threaded on Murphy needle No. 3, tissue forceps, scissors
8. Skin closure.	8. 2 Skin forceps, skin hooks, silk No. 4-0, fine wire or dermal threaded on Keith needle, scissors
9. Dressings are applied to wound surfaces.	9. 4 by 4 compresses, adhesive strips

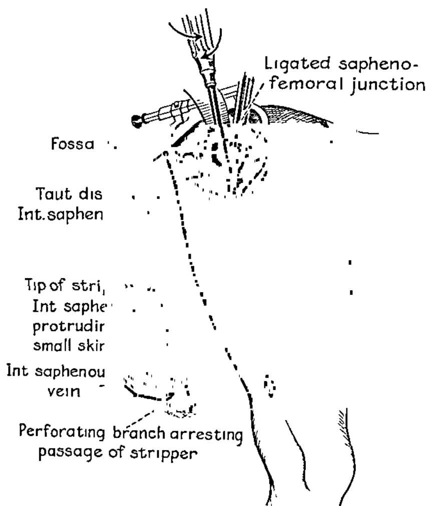


Fig 259 —Extraluminal stripper, showing the instrument with the saphenous vein arrested by a large branch in the mid-thigh At this site the end of the instrument is pushed through a small incision, the vein is removed from the ring, and the instrument is withdrawn. Segmental removal of the saphenous vein is continued to the ankle (From Theis, F. V., and Helmen, R T., S Clin North America 35.285, 1955)

Steps	*Items*
4. The saphenous vein and branches are doubly ligated or transfixed, clamped, and divided.	4. Surgical gut, chromic, or plain No. 2-0, 0, or 1 or silk No. 3-0 or 2-0, Mayo-Pean hemostats, scissors, transfixion suture threaded on Murphy needle No. 3 on needle holder
5. The proximal stump is dissected upward to the point where it enters the femoral vein where it is carefully religated. The distal stump may be injected with a sclerosing solution. The varicose veins may be ligated.	5. Curved Metzenbaum scissors, small hemostats, suture ligature. 15 ml. Luer-Lok syringe; 1 intravenous needle, gauge 20, 1½ inches, dissecting instruments
6. The fascia and subcutaneous tissue are closed.	6. Interrupted sutures, plain No. 0 or chromic No. 2-0. Silk No. 3-0 threaded on Murphy needle No. 3, tissue forceps, scissors
7. The skin edges are approximated. Dressings are applied to the wound surfaces.	7. Skin hooks, tissue forceps, silk No. 4-0 threaded on Keith needles

Excision of Saphenous Veins

Definition.—Ligation and excision of saphenous veins.

Purpose.—To treat extensive varicosities of the lower extremities.

Setup, Position, Skin Preparation, and Draping Procedure.—As for saphenous vein ligation, plus additional Kelly or Crile hemostats, and vein strippers, preferred type, and orthopedic draping pack for a leg (Fig. 259).

The patient is placed in a supine or semilateral position, with affected leg slightly abducted, knee flexed, and leg and foot supported. The entire leg and groin region are cleansed in the routine manner (Chapters 3 and 17). The patient is draped with sheets as for an operation on the leg (Chapter 17).[13, 68, 76]

Operative Procedure.—The steps, as shown in Figs. 258 and 259, and items include the following:

Steps	*Items*
1 The incision is made in the upper thigh, parallel to the crease in the groin. Bleeding vessels are clamped and ligated.	1 Knife, tissue forceps, gauze sponges, Crile hemostats, ligatures, surgical gut plain No. 3-0 or silk No. 4-0; straight scissors
2. The saphenous vein is exposed and ligated.	2. Procedure as for high ligation of saphenous vein
3. The distal end of the saphenous vein is threaded on the stripper. The stripper is pushed downward to a point near the knee	3 Mayo or Babcock vein stripper, thumb forceps, Mayo-Pean hemostat, small sponges on holders
4. A second small incision is made at a point near the knee (Fig 259)	4 Knife, tissue forceps, Crile hemostats, ligatures, small retractor, if necessary

A traumatic aneurysm results from a stretching of the injured arterial wall due to the formation of an enlarging sac. This type of aneurysm usually appears in the extremities. An arteriovenous aneurysm may result from a congenital condition, or an injury in which there is a direct communication between the veins and arteries.[13, 36, 39, 68, 69, 73, 77]

Setup, Position, Skin Preparation, and Draping Procedure.—The setup will depend upon the diagnosis and upon the age of the patient. Basic instrument setup includes the following:

Minor dissecting setup
Basin set
Glove set
Gown pack
Draping sheets, suitable type
Retractors, type and size to suit site of vein or artery

For Exploration and Repair of Artery or Vein

4 Webster hemostats
12 Mayo-Kelly hemostats, curved
12 Halsted hemostats, straight
2 Plastic dressing forceps
2 Tissue eye forceps
2 Adson dressing forceps
1 Metzenbaum scissors
2 Stevens tenotomy scissors
1 Hartmann dressing forceps
2 Scalpel handles Nos. 3 and 7 with blades Nos. 10 and 15
1 Needle holder, light type
4 Arterial forceps, desired type
2 Dural hooks
1 Cushing vein retractor
1 Adson aneurysm needle
1 Frazier dural elevator
3 Brain spoons, small size
2 Adson suction tubes
Petrolatum
Catheters Nos. 10, 12, and 14
Eye dropper, blunt tip
Suction set
Asepto syringe
Aspirating needle, gauge 18, blunt point
Syringe, 30 ml.
Arterial plastic sutures, silk Nos. 4-0, 5-0, and 6-0 swaged-on needles
Sutures for wound closure, desired types and sizes
Elastic bands, if desired
Umbilical tape
Compressed cotton sponges
Laparotomy pads
Normal saline solution
Skin preparation setup
Cardiac arrest setup

The patient is placed on the operating table in a position necessary to expose the proposed operative site. Routine cleansing procedure is gently carried out, and the patient is draped with sheets in such a manner as to leave the operative site exposed.

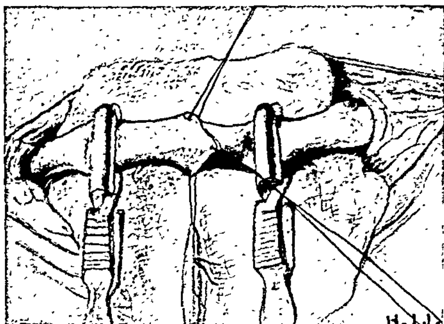
Operative Procedure.—The overlying tissues are incised. To expose, explore, and repair an artery or vein, steps and items include the following:

Steps	*Items*
1. An incision is made, freely exposing the artery.	1. Knife, tissue forceps, Crile hemostats, fine ligatures and scissors
2. The artery is usually occluded above and below the embolus or injury; or establishment of continuity of the artery may be done by vein graft with vitallium tubes.	2. Dura hook, retractors, 2 Bainbridge or arterial anastomosis clamps or tape

Operations on Great Arteries and Veins

Definitions.—Endoaneurysmorrhaphy. Matas operation for radical cure of aneurysm includes arresting circulation to the sac, also opening, evacuating, and cleansing the sac and closing the openings by continuous fine sutures with obliteration of the sac.

Considerations.—There are several types of arterial operations performed to treat different arterial conditions. They are done to treat an injured artery, to remove a lesion or blood clot (thrombus) in an artery or vein, or to treat a saccular dilatation of a blood vessel (a traumatic or arteriovenous aneurysm).



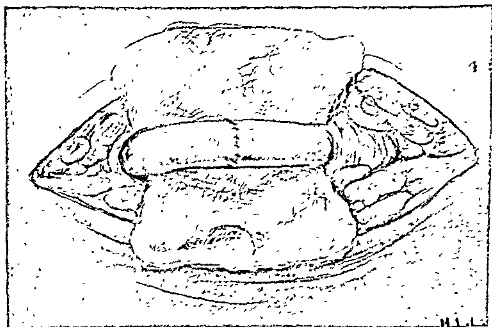


Fig. 260.—The three sutures are tied and the upper third is ready for suturing. The suturing has been completed and the current of blood has been turned on. (Carrel.) (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co.)

The major predisposing factors that contribute to cardiac arrest include insufficient preoperative dosage of atropine, overdosage of a preanesthetic drug, and excessive administration of certain drugs such as digitalis or quinidine. Other factors are cardiac disease, decreased vital capacity, anemia, anxiety, shock, abnormally elevated body temperature, and rapid induction of an anesthetic agent. In some cases the vital capacity of the lung is lowered due to pulmonary disease, emphysema, hemorrhage in the lungs, pressure, pneumothorax, or pulmonary edema (Chapter 9). The position of the patient also influences the vital capacity of the lungs (Chapter 4).

Purpose.—To re-establish the oxygen system and restore the heartbeat.

Nursing Measures.—Each member of the nursing staff must know how to assemble and use the equipment. After the physicians have formulated a written plan of procedure, it should be demonstrated; then practice sessions should be carried out at frequent intervals.[22, 33, 34] All newly employed members of the operating team should be oriented to the plan, the sterile setup, and the pieces of equipment to be used. This is a most important step of preparedness, since in such an emergency time is an essential element. The personnel should not take time to apply perfect aseptic techniques, such as shaving the proposed operative site and draping the patient with many sterile sheets. The nurse should know what is and is not to be done.[23, 35, 37]

The equipment needed for this treatment must be checked daily and be ready for immediate use. Adequate wall and pump suction setups and compressed air should be available. When the patient is treated by electric shock, both patient and operator must be insulated and all safety measures carried out.

Setup.—The following items should be kept on a cart, ready for immediate use:

Laryngoscope
Endotracheal tubes and connections
Lubricating jelly
Face mask
Oxygen bag
Oxygen 100 per cent
Mechanical respirator
Defibrillating machine with sterile pantaloons for wires
Suction cups (sterile)
Electrodes (sterile)
Transformer

Sterile Instrument Setup

1 Chest retractor
2 Sponge-holding forceps
1 Scalpel
2 Tissue forceps
4 Mayo-Pean hemostats, curved
4 Crile hemostats, straight
1 Mayo scissors
1 Needle holder
2 Medication cups
1 Syringe with metal tip
1 Syringe with glass tip if desired
1 Syringe, 10 ml.
2 Ampules procaine solution 1 per cent
2 Ampules epinephrine solution 1:1,000
10 Gauze compresses
4 Towels
1 Sheet
4 Silk No. 3-0 for ligatures
2 Silk Nos. 3-0 and 4-0 and swaged-on needles for sutures

Also

Stimulant tray with sterile New York Hospital rib-spreading wedge and scalpel wrapped sterile in silver foil

Steps	*Items*
3. Arterial sutures are placed in the vessel. The free ends of the sutures are retracted so that the incision may be made in the artery.	3. Dura hook retractors or Crile hemostat is placed under the artery; arterial silk No. 4-0 or 8-0; sutures, mosquito hemostats, plastic tissue forceps
4. A nick or small incision is made at the distal end of the portion of the clamped artery.	4. Scalpel handle No. 3 with blade No. 15, fine scissors, mosquito hemostat, cotton squares
5. The segment of the artery between the clamps is irrigated with normal saline solution. The clot is removed.	5. Syringe filled with saline solution, cotton squares; anticoagulants; aspiration set; synthetic hemostatic substances
6. Sutures are then tied.	6. Fine tissue forceps, scissors
7. The wound is closed in routine manner.	7. Interrupted sutures, plain or chromic gut No. 0, silk No. 4-0, types of sutures depending upon the location of the operation

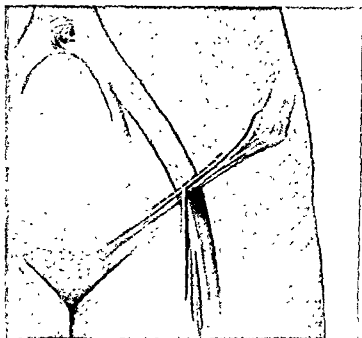


Fig. 261.—Location of incision for the exposure of femoral or iliac vessel. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N. J.)

Cardiac Resuscitation

Definition.—Opening the chest cavity, aerating the lungs, massaging the heart, and injecting stimulants into the ventricular chamber of the heart.

Considerations.—Cardiac arrest is usually caused by a lack of oxygen in the vital tissues. One of the gravest hazards to the patient on the operating table is anoxia because of the effects on the brain and myocardium even when the oxygenation process is transitory.[22,23,34,35,39,48,49]

3 Blalock clamps
2 Potts modified bulldog clamps, curved
2 Potts coarctation clamps
1 Satinsky vena cava clamp, or 1 Potts spoon forceps
Sutures, as for closure of the chest wall, and arterial silk Nos. 3-0, 2-0, and 0, swaged-on needles

Position, Skin Preparation, and Draping Procedure.—The patient is placed on the operating table with his right side uppermost. The thoracicoabdominal approach is described in Chapter 11, and lateral position in Chapter 9.

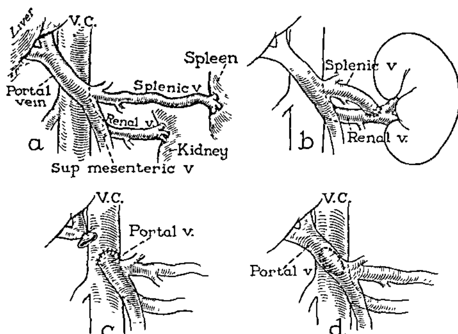


Fig. 262.—Diagrammatic representation of different types of portacaval shunts *a*, Principal structures concerned. *b*, Splenectomy with end-to-side splenorenal anastomosis. *c*, End-to-side portacaval anastomosis *d*, Side-to-side portacaval anastomosis (From Hallenbeck, G.: S. Clin. North America 35:1099, 1955)

Operative Procedure.—The steps, as shown in Fig. 262, and items include the following:

Steps	*Items*
1. The incision is made through the right thoracicoabdominal region and through the bed of the eighth or ninth rib.[81] The rectus and oblique abdominal muscles and the thoracic muscles are divided along the line of incision down to the peritoneum and pleura. The diaphragm is divided from the costal cartilages.[83]	1. Scalpel, tissue forceps, sponges, scissors, Crile and Mayo-Pean hemostats, ligatures, chromic gut No. 2-0, rib dissector and periosteotome, Parker and Richardson retractors, rib cutter and rongeur, if desired, moist packs, towels and and towel forceps, curved scissors, basin for skin instruments, clean knife, silk No. 0, scissors, suction set, packs, and self-retaining chest retractor

Operative Procedure.—The patient is placed on the operating table in supine position and his left arm supported on an armrest. An endotracheal tube is introduced, and the lungs are inflated and deflated by compression of the rubber bag which is filled with 100 per cent oxygen. An incision large enough to expose the heart is made in the chest and the heart massaged to circulate the oxygen-laden blood. The massage time is counted and followed to ensure adequate blood pressure.

When the patient is given electric shock treatment, the electrodes are placed on each side of the heart's ventricle. Then they are squeezed together to displace the blood. The suction-cup electrodes are used when the heart has lost its muscular tone and when the peripheral vascular system has collapsed. In some instances the descending thoracic aorta is pinched for alternate periods of 30 seconds each to direct the blood which has been ejected from the heart by massage into the brain and coronary arteries.[48, 49]

The chest wound is tightly closed. A rubber catheter is introduced into the pleural cavity to remove accumulated air; then the lungs are inflated and the catheter is removed. The patient is kept flat in a supine or a slightly Trendelenburg position until he has reacted completely, and then turned on the affected side. The room is kept cool, the patient is lightly covered, and constant nursing care is given. The items kept at the patient's bedside are a pneumothorax set, a tracheotomy set, an aspiration set, a stimulant tray, and suction and oxygen therapy equipment.

Shunt Operations for Partial Hypertension

Portacaval Anastomosis

Definition.—Through a right thoracicoabdominal incision, an anastomosis is established between the portal vein and the inferior vena cava.[13,73,75,79-81,83,89]

Setup.—Major celiotomy setup (Chapter 11), pneumonectomy or breast fenestrated sheet, and additional instruments as follows:

- 1 Alexander or Davidson costal periosteotome
- 1 Lambert-Berry, Doyen, or Matson rib raspatory and elevator
- 1 Schneider rib raspatory
- 1 Semb dissector
- 2 Israel or Kraske retractors
- 1 Finochietto retractor
- 4 Deaver or Meyerding retractors
- 2 O'Brien or Sauerbruch retractors, desired width
- 1 Tudor Edwards, or Semb, rib cutter
- 1 Sauerbruch or Stille-Luer rib rongeur
- 1 Nelson or Mayo-Harrington scissors, curved, 10 inches
- 1 Adson dura scissors
- 1 Satinsky scissors, curved
- 1 Potts-Smith, or Adson needle holder, 7¼ inches
- 2 Adson or Frazier suction tubes, large size
- 2 Adson tissue forceps
- 6 Adson artery forceps
- 12 Kelly artery forceps, straight jaws
- 4 Dieffenbach serrefine clamps, straight
- 6 Judd-Allis forceps
- 4 Pean or Carmalt forceps, curved jaw, 18 inches
- 4 Carmalt forceps, curved jaw, 10 inches
- 4 Overholt angular artery forceps, 6¼ or 7 inches, or Shallcross cystic duct forceps

Splenorenal Anastomosis

Definition.—Through a left thoracicoabdominal incision an anastomosis is established between the splenic and the left renal vein.

Setup and Preparation of the Patient in Surgery.—As for portacaval shunt, except the patient is placed on the table with his left side uppermost.

Operative Procedure.—The steps include the following:

1. A transverse incision is made through the ninth rib; the recti and thoracic muscles, the costal cartilages, and the pleura diaphragm are incised.[82, 84]
2. The spleen is mobilized, and the pancreas is separated from the splenic pedicle; the phrenocolic ligament is divided (Fig. 262).
3. The spleen is removed, using angular and curved artery forceps and chromic gut sutures (Chapter 13).
4. The renal vein is dissected free, and anastomosis clamps, Blalock or Potts, are applied.
5. An anastomosis of the splenic to the renal vein is carried out.
6. The wound is closed as for portacaval shunt operation.

REFERENCES

1. Anthony, C. P: Textbook of Anatomy and Physiology, ed. 4, St. Louis, 1955, The C. V. Mosby Co.
2. Bailey, C. P.: Surgery of the Heart, Philadelphia, 1955, Lea & Febiger.
3. Brown, J. W: The Congenital Heart Disease, New York, 1953, Staples Press, Ltd.
4. Callander, C. L.: Surgical Anatomy, ed. 11, Philadelphia, 1952, W B Saunders Co.
5. Christopher, F.: Textbook of Surgery, ed 6, edited by David, L, Philadelphia, 1956, W. B Saunders Co
6. Taussig, H B L: Congenital Malformations of the Heart, New York, 1947, The Commonwealth Fund
7. Edwards, J E, and others: An Atlas of Congenital Anomalies of the Heart and Great Vessels, Springfield, Ill, 1954, Charles C Thomas, Publisher.
8. Birnbaum, G. L Anatomy of the Bronchovascular System: Its Application to Surgery, Chicago, 1954, Year Book Publishers, Inc.
9. Gross, R. E The Surgery of Infancy and Childhood. Its Principles and Techniques, Philadelphia, 1953, W. B Saunders Co., chaps 60-64.
10. Brock, R. C: The Surgical and Pathological Anatomy of the Mitral Valve, Brit. Heart J. 14:489, 1952
11. Johnson, J The Surgery of Congenital Heart Disease, S. Clin North America 31:1811, 1951.
12. Kaplan, H. S, and Robinson, S J: Congenital Heart Disease and Illustrated Diagnostic Approach, New York, 1954, McGraw-Hill Book Co
13. Moseley, H F.: Textbook of Surgery, ed. 2, St Louis, 1956, The C. V. Mosby Co
14. Blalock, A, and Taussig, H. B.: Surgical Treatment of Malformations of the Heart in Which There Is Pulmonary Stenosis or Pulmonary Atresia, J.A.M.A. 109:202, 1945
15. Blalock, A, and Hanlon, C R: The Surgical Treatment of Complete Transposition of the Aorta and the Pulmonary Artery, Surg Gynec & Obst 90:1, 1950
16. Burke, E C., Kirklin, J. W, and Edwards, J E Sites of Obstruction to Pulmonary Blood Flow in the Tetralogy of Fallot An Anatomic Study, Proc Staff Meet. Mayo Clin. 26:498, 1951.
17. Blalock, A.: A Consideration of Some Problems in Cardiovascular Surgery, J. Thoracic Surg 21:543, 1951.

Steps	*Items*
2. The peritoneum is divided, and the duodenum and common duct are dissected free and retracted mesially to expose the portal vein and inferior vena cava. Portal pressure is measured.	2. Scalpel, scissors, hemostats, moist packs, Deaver retractors, Nelson or Harrington scissors, long tissue forceps with 1 and 2 teeth, moist packs, long forceps, flexible retractor, suction set, Kelly forceps, Carmalt hemostats
3. The portal vein and inferior vena cava are dissected free from their bifurcation at the liver down to the splenic vein. The cystic and pyloric veins are ligated, if necessary.	3. Long scissors and tissue forceps, Judd-Allis forceps, Pean or Carmalt forceps, Shallcross cystic duct or Overholt forceps, moist packs, cotton sponges, suction set, ligatures, chromic gut Nos. 0 and 2-0
4. The portal vein is ligated or incised. It may be irrigated with saline solution. If a side-to-side anastomosis is to be established, the portal vein is not severed.	4. Blalock clamps, saline solution, Asepto syringe, suction set, moist, small packs, chromic gut No. 0, swaged-on needle, silk No. 2-0, bulldog clamps, 2 Potts coarctation clamps
5. The wall of the vena cava is selected for the anastomosis and occluded from the lumen of the vessel (Fig. 262).	5. Satinsky clamp, Satinsky scissors, Potts coarctation clamp or modified bulldog clamp
6. For an end-to-end anastomosis a longitudinal incision is made in the vena cava of a sufficient length to suit the diameter of the cut end of the portal vein; for a side-to-side anastomosis the incision is made in the portal vein after it has been occluded.	6. Adson or Satinsky scissors and tissue forceps, Frazier or Adson suction tube, Adson artery forceps
7. The anastomosis is completed by a continuous mattress suture and interrupted sutures which are placed in the corresponding layers of the vein and artery.	7. Silk No. 5, swaged-on needle, oil, Potts-Smith needle holders, Adson tissue forceps
8. The clamps are removed, and the portal pressure is taken. The catheter is placed in the pleural cavity.	8. Manometer drainage catheter
9. The diaphragm is closed. The lung is re-expanded. The ribs are approximated, and the intercostal cartilages are closed.	9. Silk No. 2-0, Mayo needle holders, tissue forceps, silk No. 0 or chromic gut No. 0
10. The wound is closed in layers applying continuous suctioning, and dressings are applied.	10. As for celiotomy, underwater seal drainage set, and dressings

48. Leeds, S. E.: Cardiac Resuscitation, J.A.M.A. 152:1409, 1953.
49. Wolfe, K, and Rand, J. H: Electro-Mechanical Aids in Resuscitation and Anesthesia, Ohio M. J. 46:39, 1950.
50. McPheeters, H. O., and Kusz, C: The Ligation and Stripping in Treatment of Varicose Veins, Surgical Flim Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn. (Film).
51. Kallus, A. A, and Mueller, W. H.: Patent Ductus Arteriosus With Reversal of Blood Flow, Ann. Surg 138:870, 1953.
52. Scott, H. W., Jr.: Closure of the Patent Ductus by Suture-Ligation Technique, Surg. Gynec. & Obst. 90.91, 1950.
53. Scott, H. W., Jr.: Surgical Treatment of Patent Ductus Arteriosus in Childhood, S. Clin. North America 10:1299, 1952.
54 Conklin, W. S, and Watkins, E: Use of the Potts-Smith-Gibson Clamps for Division of Patent Ductus Arteriosus, J Thoracic Surg. 19:361, 1950.
55. Crafoord, C: Closure of Patent Ductus Arteriosus, J. Thoracic Surg. 16:322, 1947.
56 Gross, R. E.: Complete Division for the Patent Ductus Arteriosus, J. Thoracic Surg 16:314, 1947.
57. Jones, J.: Surgical Division of Patent Ductus Arteriosus, Ann. Surg. 130·174, 1949.
58. Bailey, C., Balton, C., and Morse, D: The "Right" Approach to the Problems of Mitral Stenosis, S. Clin. North America 8:931, 1956.
59. Adams, H. O, Rutledge, D. I, and Sanders, C R: Coarctation of the Aorta, J.A.M.A. 139:362, 1949.
60. Bahnson, H T: Coarctation of the Aorta and Anomalies of the Aortic Arch, S. Clin. North America 10:1313, 1952.
61. Clagett, O T, and Jampolis, R W.: Surgical Treatment in Coarctation of Aorta, A M A. Arch Surg 63:337, 1951.
62. Cooley, J. C, and others Coarctation of the Aorta Associated With Patent Ductus Arteriosus, Circulation 13 843, 1956.
63. Crafoord, C, and Nylin, G Congenital Coarctation of the Aorta and Its Surgical Treatment, J Thoracic Surg 14:347, 1945.
64. Gross, R E. Coarctation of Aorta, Surgical Treatment of 100 Cases, Circulation 1:411, 1950
65. Hurwitt, E S, and Brahms, S A· Coarctation of the Aorta, Am. Surgeon 133.200, 1951.
66. Potts, W J Technique of Resection of Coarctation of the Aorta With Aid of New Instruments, Am Surgeon 131:466, 1950
67. Bailey, C. P. The Surgical Correction of Aorta Stenosis, Surgical Film Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn (Film).
68. Foote, J Varicose Veins, ed 2, St. Louis, 1954, The C V. Mosby Co
69 Allen, E V.. Peripheral Vascular Diseases, Philadelphia, 1955, W. B. Saunders Co
70 Barrow, D W The Clinical Management of Varicose Veins, ed 2, New York, 1956, Paul B Hoeber, Inc
71. Ciba Foundation An Atlas of Peripheral Circulation in Man (Chest and Heart), Boston, 1954, Little, Brown & Co
72 Ochsner, A, and DeBakey, M. E Christopher's Minor Surgery, ed 7, Philadelphia, 1955, W B Saunders Co, chaps 15, 16
73 Shackleford, R T: in Lewis' Practice of Surgery, Hagerstown, Md, 1955, W. F. Prior Co.
74. Theis, F. V, and Helman, R T. Surgical Treatment of Varicose Veins and Ulcers, S. Clin North America 2.285, 1955
75 Hallenbeck, G.· Portacaval Anastomosis: Rational Indications and Techniques, S. Clin. North America 8:1099, 1955.
76 Myers, T· Management of Varicose Veins and Special Reference to the Stripping Operations, S Clin North America 8:1147, 1955.
77. Pratt, G. H: Surgical Treatment of Arteriovenous Aneurysm, Surgical Film Library, Surgical Products Division, American Cyanamid Co., Danbury, Conn (Film).

18 American Heart Association: Modern Concepts of Cardiovascular Disease, New York, 1955, American National Heart Association, Inc.
19. Smith, E. M.: A Nursing Staff Prepares for Cardiac Surgery, Am. J. Nursing 49:589, 1949
20. Brock, R C: Direct Cardiac Surgery in the Treatment of Congenital Pulmonary Stenosis, Ann. Surg. 136:63, 1952.
21. Ellis, F. H, Kirklin, J., and Clagett, O. T.: Tetralogy of Fallot, S. Clin. North America 8:1013, 1955.
22. Hosler, R. M.: A Manual on Cardiac Resuscitation, Springfield, Ill., 1954, Charles C Thomas, Publisher.
23. Hosler, R. M.: The Emergency Treatment of Cardiac Arrest in the Operating Room, J Am. Nurse Anesthetist 20:18, 1952.
24. Holman, E: Pulmonary Stenosis, Left Subclavian to Left Pulmonary Artery Anastomosis, J. Thoracic Surg. 18:827, 1949.
25. Potts, W J: Tetralogy of Fallot, Am. J. Nursing 47:298, May, 1947.
26. Potts, W. J.: Surgical Treatment of Congenital Pulmonary Stenosis, Ann. Surg 130:342, 1949.
27. Potts, W. J., Gibson, S, Riker, W. L., and Leiminger, C. R: Congenital Pulmonary Stenosis With Intact Ventricular Septum, J.A.M.A. 144:8, 1950.
28 Potts, W. J, and Riker, W. L· Surgical Treatment of Pulmonary Stenosis With Intact Interventricular Septum, A.M.A. Arch. Surg. 62:776, 1951.
29. Wallace, M.: Care of the Child With Tetralogy of Fallot, Am. J. Nursing 52:233, Feb., 1952.
30. Brock, R. C. Pulmonary Valvulotomy for Relief of Congenital Pulmonary Stenosis, Brit. M. J 1:1121, 1948.
31. Glover, R. P., Bailey, C. P, and O'Neill, T. J. E. Surgery of Stenotic Valvular Disease of the Heart, J.A M.A 144:1049, 1950.
32. Kirklin, J. W, Openshaw, C. R., and Thompkins, R. G.: Surgical Treatment of Infundibular Stenosis With Intact Ventricular Septum, Ann. Surg. 137:228, 1953.
33. Beck, C. S, and Rand, J. H· Cardiac Arrest During Anesthesia and Surgery, J.A.M.A. 141:1230, 1949.
34 Freedom, R V., and others Major Neuropsychiatric Residuals Following Resuscitation From Cardiac Arrest, J.A.M A 155:107, 1954.
35 Hosler, R. M. Cardiac Resuscitation, Am. J Nursing 56:424, April, 1956.
36 Ciba Foundation: Visceral Circulation, Boston, 1953, Little, Brown & Co.
37 Jeans, P C, Wright, F. H, and Blake, F. G: Essentials of Pediatrics, ed 5, Philadelphia, 1955, J. B Lippincott Co, chap 10
38 Andrus, E. C, Blalock, A, and Milner, W: Pulmonary Stenosis, A.M.A. Arch Surg. 67:790, 1953.
39 Adams, H. D, and Boyd, D. P.· Surgical Treatment of Aortic Aneurysm, S. Clin North America 6·619, 1956
40 Bailey, C. P, Olson, A K, and Nicholas, H. T: Commissurotomy for Mitral Stenosis; Technique for Prevention of Cerebral Complications, J.A.M.A. 194:1085, 1952.
41 Bailey, C P, Glover, R P, and O'Neill, T. E Surgery for Mitral Stenosis, J. Thoracic Surg 19:16, 1950
42. Glover, R P, O'Neill, T E, and Harris, J S Mitral Stenosis, J. Thoracic Surg 25:55, 1953
43 Harken, D. E, Ellis, L. B, and Norman, L R· Surgical Treatment of Mitral Stenosis, J. Thoracic Surg 19.1, 1950.
44. Hurwitt, E. S., and others Appraisal of the Surgical Treatment of Mitral Stenosis, Ann Surg. 138:219, 1953
45. Julian, D. C, and others Surgical Treatment of Mitral Stenosis, A.M.A. Arch. Surg 65:621, 1952.
46 Kirklin, J. W, and Ellis, F. H Mitral Stenosis, S Clin North America 8:1040, 1955
47. Adams, E. H., and Forsyth, W. B· The Effects of Surgery on the Growth of Patients With Patent Ductus Arteriosus, J. Pediat. 39:330, 1951.

CHAPTER 11

ABDOMINAL INCISIONS—WOUND CLOSURE AND REPAIR

The surgeon chooses an incision which will afford adequate exposure of the structures to be operated upon, ensure minimal trauma, permit proper closure of the wound layers, and provide for primary wound healing.[1-10] The major factors which affect primary healing are described in Chapters 2 and 5. The regions of the abdominal wall, the superficial and underlying structures, and the location of various incisions are illustrated in Figs. 263 to 266.

TYPES, USE, LOCATION, AND CLOSURE OF INCISIONS

The paramedian rectus incision is used in upper, mid, or lower abdominal operations on the right or left side (Figs. 266 and 267.) It is made parallel and about 4 cm. lateral to the midline. The skin and subcutaneous tissue are incised, the anterior sheath is divided, and the rectus muscle is separated and retracted laterally, thus preserving the motor nerves. The posterior rectus sheath and peritoneum are opened vertically.

In suturing the wound, the posterior rectus sheath and peritoneum are closed in one layer; then the anterior rectus sheath is approximated (Chapter 5).

For resection of the rectum and the sigmoid colon, a paramedian rectus incision usually extends from the symphysis pubis to a point above the level of the umbilicus. For gynecologic surgery a similar incision is made on either the left or right side. For operations in the hypogastric area and right iliac region the incision is made shorter and extends below the umbilicus on the right side (Fig 267). For exposure of the liver, gall bladder, or pancreas, the incision is made in the upper abdomen on the right side. A similar incision is made on the left side to expose the stomach or the spleen (Figs. 263 to 266).[2,11-13]

The peritoneum and the posterior sheath are approximated and closed with a continuous suture or interrupted sutures of surgical gut. The posterior sheath may be approximated with interrupted sutures, using cotton or silk. Fascial layers are carefully approximated with interrupted sutures, using cotton, silk, surgical gut, or steel wire (Chapter 5.)

The superficial fascial layers are closed with interrupted fine sutures. The skin edges are closed with silk, cotton, or nylon. Tension sutures may be used (Chapter 5).

78 Beck, C. S., and Leihninger, D. S: *Scientific Basis for the Surgical Treatment of Coronary Artery Disease*, J.A.M.A. 159:1264, 1955.
79. Blakemore, A H: Portacaval Shunting for Portal Hypertension, Surg. Gynec. & Obst 94:443, 1952.
80 Linton, R R. Selection of Patients for Portacaval Shunts, With Summary of Results in 61 Cases, Ann Surg 134:133, 1951.
81. Satinsky, V. P.: Thoracicoabdominal Approach for Portacaval Anastomosis, Ann. Surg 128: 938, 1948
82 Welch, C. S: Splenorenal Anastomosis for Portal Hypertension, Surgical Film Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn. (Film)
83. Welch, C S: Portacaval Anastomosis, Surg Gynec. & Obst. 85:492, 1947.
84 Blakemore, A H, and Lord, J. W, Jr.; Splenorenal Anastomosis and Portacaval Anastomosis, Ann Surg 121:435, 1945
85. Blalock, A G: *Surgical Treatment of Tetralogy of Fallot, Surgical Film Library, Surgical* Products Division, American Cyanamid Co, Danbury, Conn. (Film).
86 Henderson, L: Nursing Care of the Patient With a Mitral Valvulotomy, Am J. Nursing 54:424, April, 1954.
87 Hufnagel, C. A Surgery of Acquired Diseases of the Cardiac Valves, GP 7:69, Feb, 1953
88 Bolton, H, and others. Commissurotomy for Mitral Stenosis, Surgical Film Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn (Film).
89 Heaney, J P.: Portacaval Shunt, Surgical Film Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn (Film).

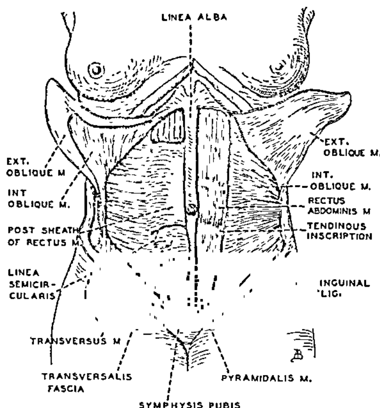


Fig 265 —Anatomy of abdominal wall· deep (From Greenhill, J. P: Surgical Gynecology, Chicago, 1956, The Year Book Publishers, Inc)

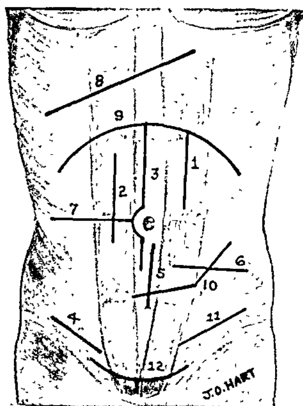


Fig. 266 —*Incisions* made through the abdominal wall *1,* Left upper paramedian rectus; *2,* right mid-paramedian rectus; *3,* longitudinal midline; *4,* right McBurney muscle-splitting; *5,* lower midline; *6,* left lower transverse, *7,* midline transverse; *8,* right oblique (subcostal); *9,* upper inverted "U"; *10,* diagonal, *11,* left lower oblique; *12,* Pfannenstiel (transverse).

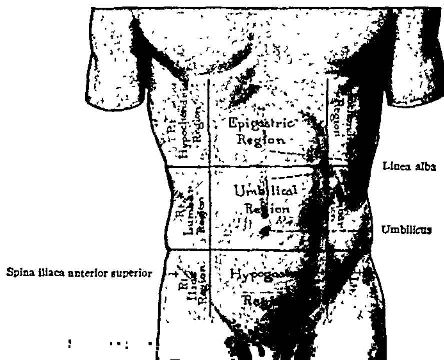


Fig 263 —The regions of the abdominal wall. (From Anson, B, and Maddock, W: Callander's Surgical Anatomy, Philadelphia, 1952, W B. Saunders Co)

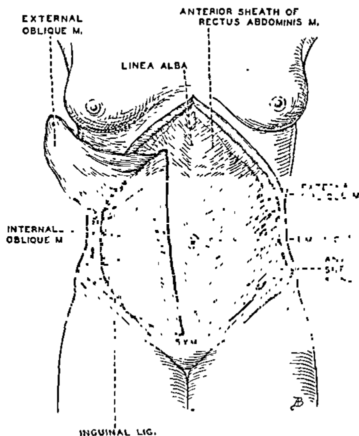


Fig 264.—Anatomy of abdominal wall. superficial (From Greenhill, J P.: Surgical Gynecology, Chicago, 1956, The Year Book Publishers, Inc.)

incision is made on the left side for drainage of an abscess due to diverticulitis, or for a sigmoid colostomy (Figs. 263 to 266).

The incision, which is about 8 cm. long, begins above a line between the anterior superior spine and the umbilicus, about 4 cm. medial to the anterior superior spine. This incision extends downward and inward, parallel to the fibers of the external oblique muscle and fascia. The external oblique muscles and the fascia are split in the direction of their fibers and then retracted. The internal oblique muscle and the transversalis muscle and fascia are split horizontally in the direction of their fibers. The peritoneum is cut. The details of this incision and the nursing procedures for closure of the wound are described later in this chapter. To enlarge the McBurney or gridiron incision medially, the inferior epigastric vessels are ligated and the rectus sheath is incised transversely.

The upper quadrant transverse or oblique incision (subcostal) is made on the right side for operations on the gall bladder, common duct, or pancreas, and on the left side for splenectomy.

The oblique or transverse incision begins in the midline at the center point between the xiphoid and umbilicus, and extends laterally and slightly downward to a point in the anterior axillary line just below the lower costal margin (Fig. 263.) If the costal angle is narrow, the incision is made about three fingerbreadths below the costal margin and parallel to it (Figs. 266 and 268). Each muscle contains several veins and arteries which require ligation. If more exposure is needed, the incision is extended across the rectus muscle of the other side (Fig. 265). This muscle is retracted or divided transversely. The falciform ligament also is divided.

The closure of the upper quadrant transverse incision (subcostal) includes approximating the falciform ligament and closing the peritoneum and posterior sheath, using fine interrupted sutures, the posterior sheath to the region of the falciform ligament; then closing the anterior rectus sheath, using fine (size 0 or 2-0) interrupted sutures, and the subcutaneous fat, using plain, 5-0 or 4-0, surgical gut; and approximating the skin edges, using interrupted sutures of fine nonabsorbable material (Chapter 5).

The upper quadrant transverse or oblique incision is efficient for several reasons. It provides for adequate exposure and eliminates the need to exert heavy pressure against the abdominal wall by means of retractors. Fewer nerves need to be severed. The wound can be easily closed because of minimal pull perpendicular to the axis of the incision. The patient has less pain postoperatively. Wound complications tend to be less frequent than with vertical incisions

The upper inverted "U" abdominal incision is used for gastrectomy, resection of the transverse colon, transverse colostomy, and operations on the biliary tract (Figs. 266 and 269). The incision extends from a point just below the costal margin on one side in the anterior axillary line to the same point on the opposite side (Figs. 263 to 265) It is curved, with the midpoint lying midway between the xiphoid process and the umbilicus. The intercostal nerves are preserved.

The advantages of a longitudinal paramedian incision are as follows: the abdominal cavity can be quickly entered; the original incision can be extended upward or downward; and the pelvic cavity can be explored.

Postoperatively, if the patient has severe attacks of vomiting or coughing, the wound will be under excessive strain, which may result in wound separation or complete disruption (Chapter 5).

The longitudinal midline incision is used for gastrectomy, transverse colon resection, or for gynecologic surgery. This incision extends through the avascular linea alba in the upper or lower abdomen, exactly in the midline between the two recti muscles (Figs. 261 to 266). The incision is extended by curving it about the umbilicus. Few vessels are encountered in this tough connective tissue with fibers passing in all directions. The peritoneum is incised, and the round ligament is divided.

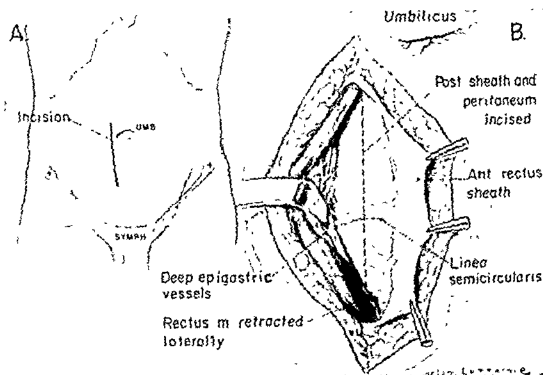


Fig 267 —*A*, The location of the vertical paramedian rectus incision is shown on the right side *B*, The anterior rectus sheath is divided, the rectus muscle retracted, and the posterior sheath and peritoneum exposed (From Horsley, G W, and Bigger, I. A: Operative Surgery, vol. II, St. Louis, 1953, The C V Mosby Co)

To close the wound, the peritoneum and round ligament are approximated with sutures, and the midline connective tissue is closed. Because the incision is at the midpoint of the transverse pull of the flat muscles from either side, the anterior rectus sheath is closed with interrupted sutures of wire or silk.[4, 14, 15] The primary suture line may be supported by through-and-through wire or nylon tension sutures. The opening of a midline incision and closure of the wound are described later in this section.

The McBurney muscle-splitting incision is used for removal of the appendix, for cecostomy, and for drainage of an appendiceal or a pelvic abscess. A similar

The incision begins slightly above or below the umbilicus on either the right or left side and is carried laterally to the lumbar region at an angle between the ribs and the crest of the ilium (Fig. 263). The skin and subcutaneous tissue are incised, and the anterior rectus sheath is split in the direction of its fibers (Fig. 265). The rectus muscle is divided at right angles, and the bleeding vessels are clamped and ligated. The posterior sheath and peritoneum are cut in the direction of the fibers of the sheath, preserving the intercostal nerves which pass over the posterior sheath (Fig. 266). The entrance to the peritoneal cavity

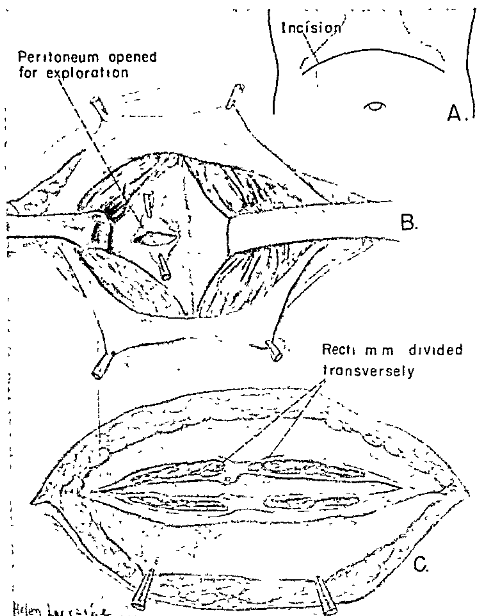


Fig 269—*A*, The position of the inverted "U" incision is shown in the upper abdomen. *B*, The anterior rectus sheath on either side is divided transversely to expose the recti muscles *C*, After division of these muscles, the posterior rectus fascia and peritoneum are divided transversely, or parallel to the fibers of the posterior sheath The falciform ligament is divided and ligated (From Horsley, G W., and Bigger, I A Operative Surgery, vol. II, St. Louis, 1953, The C. V Mosby Co)

An upper abdominal transverse incision is closed by placing interrupted sutures first in the peritoneum and posterior sheath and then in the anterior sheath. The muscle and fat are not sutured. The skin edges are approximated, using nonabsorbable sutures

The transverse mid-abdominal incision is used on the left side to expose the descending colon, the sigmoid colon, and the spleen (Figs. 266 and 270). It is used on the right side to expose the ascending colon and the cecum. This incision also is used for a retroperitoneal approach for lumbar sympathectomy, for vena cava ligation, and for removal of retroperitoneal tumors.

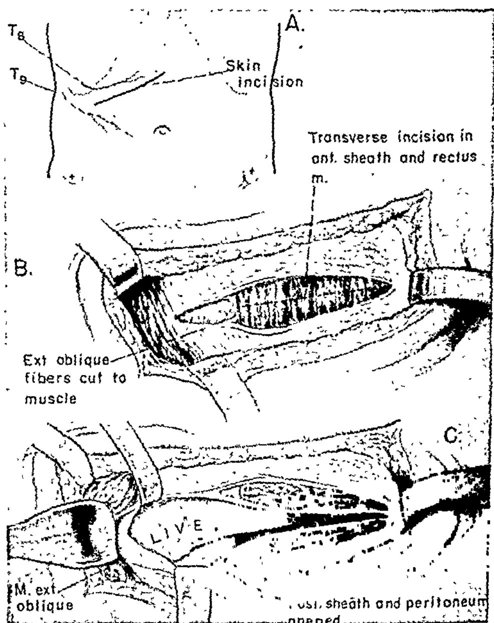


Fig 268.—*A*, The position of the transverse (subcostal) skin incision is shown in the upper right quadrant *B*, The anterior sheath has been divided transversely and the muscle is exposed *C*, The posterior sheath and peritoneum have been opened transversely. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, vol II, St. Louis, 1953, The C. V. Mosby Co)

The lower quadrant transverse incision is used for resection of the colon, especially for the abdominal part of a rectal resection or for a sigmoid resection (Figs. 264 to 266).

The skin incision is made completely across the lower abdomen, starting from the anterior superior spine on one side and curving downward, following the crest of the pelvis at a distance of two fingerbreadths, and ending at the other anterior superior spine (Fig. 263). The incision is usually made in a flexion crease.

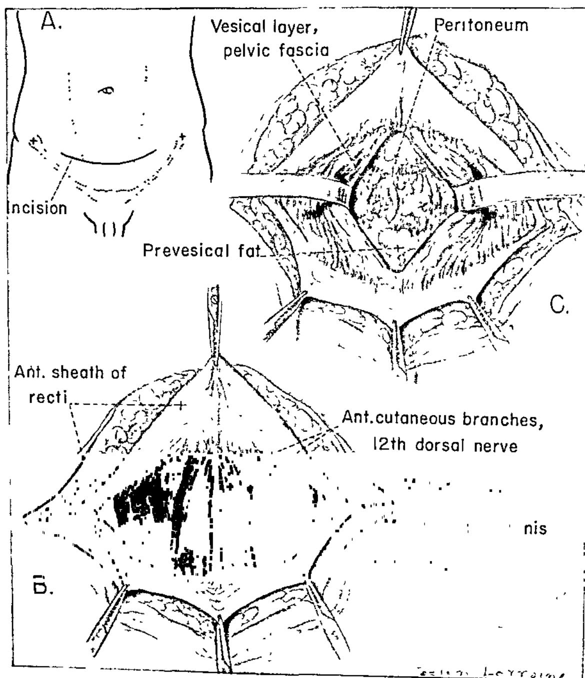


Fig 271 – Transverse (Pfannenstiel) incision. (From Dodson, A. I. Urological Surgery, St Louis, 1956, The C. V. Mosby Co)

is usually made near the midline and the incision then is extended laterally into the internal oblique muscle.

When this incision is used the operating table may be tilted toward the opposite side to provide for better exposure. If a drain is inserted it is brought out at the lateral angle of the wound.

In closing a transverse mid-abdominal incision, the peritoneum and posterior sheath are closed with interrupted sutures, and the fascial layers of the internal oblique muscle are incorporated in the sutures placed in the posterior and anterior sheaths The skin edges are closed in the usual manner.

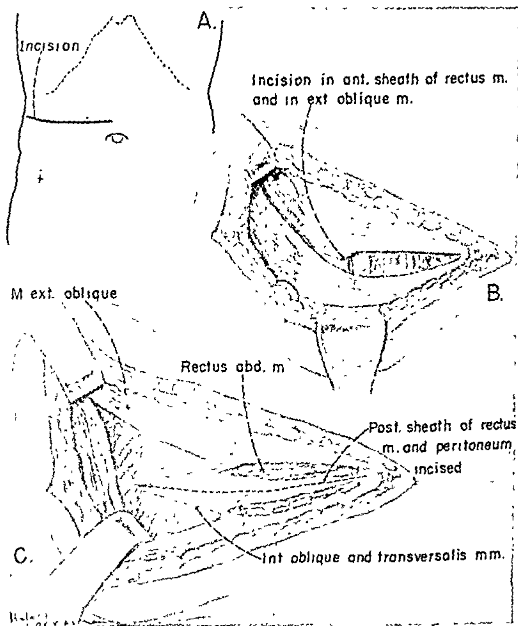


Fig 270—*A*, The mid abdominal transverse incision is shown on the right side. *B*, The anterior sheath of the rectus muscle and the external oblique muscle are incised transversely. *C*, The posterior sheath and the peritoneum are incised, and the fibers of the internal, oblique, and transverse abdominis are split to provide adequate exposure (From Horsley, G W., and Bigger, I. A.: *Operative Surgery*, vol. II, St. Louis, 1953, The C. V. Mosby Co.)

Position, Skin Preparation, and Draping Procedure

After the patient is admitted to the operating room suite, he is transferred to the operating table which is located near the door of the operating room unit. The members of the operating team (the circulating nurse and assistant worker) help move the patient onto the operating table. The patient is placed in the required position. The effects of malpositioning following surgery and the steps to be carried out in positioning a patient in a supine position are described in Chapter 4. Routine skin preparation is done (Chapter 3).[3,8,17,18] The patient is draped with a laparotomy sheet as described and shown in Chapter 4, Figs. 87, 90 to 94.

Operative Procedure in Opening of a McBurney or Lower Quadrant Muscle-Splitting Incision

The steps and the items include the following:

Steps	*Items*
1. The surgeons hold gauze compresses on each side of the proposed site, thus protecting their gloved hands from the skin.	1. Gauze compresses, basin placed on sterile field, suction setup connected and tested, then turned off until needed
2. A full-length incision is made to its whole length and generally down to the fascia (Figs. 264 and 267).	2 Scalpel for skin incision (surgeon places scalpel in basin for soiled instruments); a second scalpel handed to the surgeon; sponges, and Kelly or Crile hemostats for controlling bleeding vessels
3. The bleeding vessels are ligated. The surgeon discards the hemostats in a basin on the sterile field.	3. Surgical gut chromic No. 3-0 or plain gut No. 3-0 or 2-0, or cotton or silk No. 4-0, suture scissors; transfixion suture threaded on Murphy needle No. 3 or swaged-on suture, needle holder, tissue forceps, sponges
4. The skin towels are applied, everting the skin edges. Surgeons wash gloved hands after completing this step.	4. Two skin towels, folded in half, placing the folded edges together; hand towels, tissue forceps, and towel forceps to the surgeons

One of several methods which may be used to evert the skin edges and exclude them from the inside of the wound is as follows: (1) Two skin towels folded in half are placed together on the sterile field so that the folded edges are toward the operator and parallel to the line of incision. (2) The folded edge of the top towel is clipped at various points to the skin edges of the wound nearest the operator. The operator everts the skin edges, using tissue forceps. (3) The two towels are turned onto the other side of the wound so that the folded edge of the second towel is on top and can be clipped to the exposed skin edge. (4) The top towel is turned back on the sterile field, thereby exposing the wound

CELIOTOMY

Definition.—An opening made through the abdominal wall, and the peritoneal cavity opened. The name of the operation is usually derived from the additional procedure carried out.

Setup for an Adult.—The items, as illustrated in Chapter 4, include the following:

Instruments

2 Mayo-Collins or Parker retractors (Fig. 65)
2 Roux or Goelet retractors, suitable size
2 Richardson retractors, medium blade (Fig. 63)
2 Richardson retractors, small blade
2 Richardson retractors, large blade, optional
1 Greene retractor, optional
1 *Malleable copper, small or medium* (Fig. 68)
2 Skin hook retractors, optional
6 Foerster sponge-holding forceps
2 Pean holding forceps
16 Towel forceps
3 Knife handles, Nos. 4 and 3, with blades, Nos. 21, 20, and 10 or 15
2 Dissecting scissors, curved, 5½ inches (Fig. 42)
1 Dissecting scissors, curved, 7 inches
1 Metzenbaum scissors
1 Suture scissors, straight
1 Splinter forceps, 3½ inches, optional
3 Tissue forceps with teeth, 5½ inches (Fig. 74)
2 Tissue forceps without teeth, 5½ inches (Fig. 75)
1 Tissue forceps, 7 inches
4 Needle holders, 2 medium and 2 heavy type
4 Allis forceps (Fig. 58)
24 Crile or Hopkins hemostats, straight, 5½ inches (Fig. 52)
12 Mayo-Pean hemostats, curved, 6½ inches (Fig. 54)
4 Kocher forceps, straight, optional
2 Ochsner forceps, straight, 6½ inches
1 Abdominal suction tube and rubber tubing connection (Fig. 72)

Sutures and Needles

Chromic and plain gut to suit tissues, sizes 3-0, 2-0, or 0 (Chapter 5)
Silk, sizes 4-0, 3-0, and 2-0, or cotton, desired sizes
Nylon or wire for tension sutures with guards
4 Murphy needles, ½-circle, taper-point—2 No. 3; 2 No. 2
4 Mayo needles, ½-circle, taper-point —2 No. 3; 2 No. 2
4 Regular surgeon's needles, ⅜-circle, cutting-edge, size 4 or 3, for tension sutures
2 Keith needles, straight (swaged-on needles may be used rather than those listed here.) (Fig. 122)

Textiles

Major operating pack (Chapter 2)
Major basin set
Glove pack
Gown pack
Laparotomy fenestrated sheet
Sponge and dressing pack for abdominal surgery (Chapter 4)
Laparotomy pads, suitable size

Other Sterile Items

Skin preparation setup (Chapter 3)
Drainage set
Intravenous solutions and sets
Emergency drug set (Chapter 4)
Local set, and anesthetic solution, if desired

Unsterile Items

Armrest and restraint straps or bandage (Chapter 4)
Leg restraint, nonconductive rubber
Infusion standard
Small pillow
Small pad
Adhesive tape

Operative Procedure in Closing Celiotomy (McBurney Approach)

The wound layers in a McBurney approach are closed as follows:

Steps	*Items*
1. The peritoneum is closed usually transversely or in a purse-string manner. When drainage is not established, the internal oblique, transversalis, small opening at the outer border of the rectus sheath, and external oblique fascia are closed in layers.	1. Chromic gut No. 3-0 or plain gut No. 2-0 or 0, 18 inches, threaded or swaged-on Murphy intestinal needle No. 3, needle holder, tissue forceps with teeth, scissors, sponges on holders, laparotomy pad; account for sponges and laparotomy pads (Chapter 4)
2. The skin towels and hemostats attached to the wound are removed. The bleeding vessels are ligated. The surgeons wash gloved hands.	2. Place skin towels and towel forceps in soiled basin without allowing them to drag across the wound or sterile field; Crile hemostats, chromic gut, silk or cotton sutures, scissors, sponges
3. Two fresh towels are placed near the wound edges.	3. One towel folded in half, lengthwise, is placed on the side nearest the surgeon, turning the upper half over at right angles to the upper point of the incision; second towel is placed on the opposite and lower point of the incision
4. The wound edges are retracted and the subcutaneous tissue may be approximated. The skin edges are closed and dressings applied to the wound.	4. Chromic or plain gut No. 3-0 threaded on Murphy needle No. 2, needle holder, tissue forceps, scissors, sponges, and small retractors; skin sutures, silk, wire, or nylon, gauze compresses or other dressing preferred

Operative Procedure for Paramedian, Midline, Vertical, or Transverse Approach

The same basic technique is applied, regardless of the location or direction of the incision. The procedures are similar to opening and closing of a celiotomy through a McBurney approach; however, there are several differences. They include the following (Figs. 274 to 276):

Setup, Position, Skin Preparation, and Draping Procedure.—As for McBurney approach, except additional hemostats, sponges, pads, and deeper retractors will be needed. The position of the patient will depend upon the type of incision to be used, and the location of the lesion (Chapter 4). Routine skin preparation is carried out (Chapter 3). The patient is draped with a fenestrated laparotomy sheet or regular sheets (Chapter 4).[3,7,8,17]

Opening Procedure.—As for McBurney approach. In some cases, however, the skin edges first are protected with two towels or two laparotomy pads. Then just before the peritoneum is to be opened, or afterward, towels are secured to the wound's edges.

The peritoneum is opened with a scalpel and tissue forceps without teeth, and the peritoneal edges are grasped with forceps (Fig. 275). The incision is

with its skin edges enclosed in the towels. (5) The ends of the towels are overlapped at each end of the incision and secured with towel forceps. Tissue forceps are placed in the basin on the sterile field. (6) A towel folded longitudinally is placed across the upper end of the incision and a second one across the end of the incision.

Steps	*Items*
5. The upper and lower ends of the wound are protected with towels, and the wound edges are retracted.	5. Turned-back side of one towel placed at right angles to the upper end of the wound, and another towel placed across the lower end of the wound; hand Roux or Greene retractors to surgeon; discard soiled instruments and basin; place gauze sponges and second basin on the sterile field
6. The external oblique fascia is nicked and the edges of the fascia are grasped with tissue forceps (Fig. 264).	6. Scalpel, 2 tissue forceps with teeth, hemostats, ligatures
7. The aponeurosis of the external oblique muscle is split in the direction of the fibers for the entire extent of the incision. One bleeding vessel is usually encountered.	7. Curved scissors, Crile or Kelly hemostats, free or suture ligatures of fine chromic gut, silk, or cotton; needle holder, suture scissors
8. The external oblique muscle is retracted. The internal oblique and transversalis muscles are split parallel to the fibers up to the rectus sheath. This is usually done by blunt dissection (Fig. 265).	8. Roux or Richardson retractors, curved scissors, moist gauze sponges on holders, small pad, tissue forceps with teeth, hemostats
9. The openings in the internal oblique and transversalis muscles are retracted. The peritoneum *is exposed, grasped, and nicked* (Fig. 274).	9. McBurney or Parker retractors, tissue forceps without teeth, scalpel, Crile or Kelly hemostats, *turned on suction set*, laparotomy pad, culture tube, if desired
10. The peritoneal edges are grasped and the small opening is enlarged. The peritoneum is retracted. Abdominal exploration is carried on (Fig. 275).	10. Crile hemostats, scalpel, scissors, and sponges on holders; discard soiled sponges in basin on the sterile field (Chapter 4); Richardson retractors, wet laparotomy pads; remove all free sponges from the field

The rectus muscle may be approximated. If it has been drawn aside, as a whole, it is not sutured. The anterior rectus sheath is closed, using interrupted sutures; then the skin towels and towel forceps are removed and discarded in the basin designated for this purpose (Figs. 279 and 280). During the closure of the fascia the scrubbed nurse assembles the pieces of equipment for terminal sterilization and places the dressing set on the Mayo stand.

The wound edges are cleansed, fresh towels are placed around the wound, and tension sutures are inserted, if used. In some patients these sutures are inserted before the rectus sheath is closed. The skin edges are approximated, the tension sutures tied, and the free ends cut (Fig. 281). Suitable dressings are secured over the wound surfaces.

REPAIR OF HERNIAS

General Considerations.—A hernia is a protrusion of any viscus or tissue through a weak spot or through an abdominal opening. The term hernia usually is applied to protrusion of abdominal viscera. Hernias are classified according to their anatomic situations, as inguinal, femoral, umbilical, lumbar, incisional, diaphragmatic, and sciatic.[19, 24]

Surgical Anatomy.—The sac is a complete peritoneal pouch, which may be congenital or acquired.[12,25,26] If the contents are not adherent to the sac, they will withdraw freely into the peritoneum, but the sac remains in the abdominal wall. In a diaphragmatic hernia, a sac may or may not be present

Incarcerated hernia is a hernia that cannot be reduced; the condition is generally due to adhesions between the contents of the hernial sac and the inner lining of the sac or adhesions between the contents themselves, or due to a narrowing of the neck of the sac. These conditions prevent the return of the hernia's contents into the abdomen.

Strangulated hernia is a hernia in which the contents are irreducible (incarcerated) and, furthermore, their circulation is impaired.[22]

The contents of the sac may contain parts of the viscera, such as the omentum, loops of small or large intestine, appendix, or a Fallopian tube. The anatomic situation of the hernia will in part determine its possible contents

The coverings of the hernial sac vary. In acute cases of herniation the intestines may be pushed through the separated muscles with little covering except the peritoneum and skin. In the congenital type the sac, as it progresses through the abdominal wall, acquires a series of thin coverings, each one representing a layer of that wall.[22, 23, 25]

Repair of Inguinal Hernia (Direct or Indirect)

Definition.—Reconstruction of a weak spot in the abdominal wall, and repair of the protruding tissue in the opening, if necessary.

Surgical Anatomy.—The inguinal canal is a short diagonal pathway through the lower abdominal muscles (Figs. 264 and 265). The canal begins at the internal ring and ends at the external ring (Fig. 282). It contains the spermatic cord in the male or the round ligament in the female. The cord or round liga-

the peritoneal and posterior sheath, the scrubbed nurse places the following items on the Mayo stand: two skin hooks, two skin tissue forceps, and the desired skin sutures, such as fine silk, wire, or nylon threaded on skin needles, or metal clips with three clip holders.

Usually before the wound is closed the scrubbed nurse prepares two tension sutures (Fig. 280). These sutures and two needle holders are placed on the Mayo stand, and then others are prepared. The purposes of tension sutures and the materials used are discussed in Chapter 5. To prepare a tension suture, take a suture of the desired length, pass one end through a piece of Dakin tubing about one-half inch long. Bumpers or guards prevent the suture from cutting into the wound. Secure a hemostat to the strand to prevent the bumper from falling off. Thread the free end of the suture through the needle's eye.

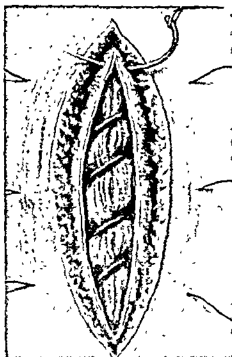


Fig 280.—Closure of rectus sheath

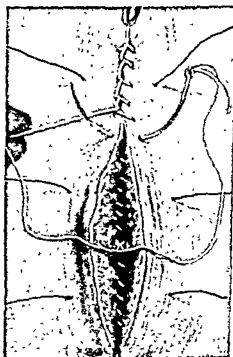


Fig. 281.—Skin closure

(From Crossen, H S, and Crossen, R J. Operative Gynecology, St Louis, 1918, The C. V. Mosby Co)

In some clinics a perforated button may be threaded onto the strands; then a second button is threaded onto the three ends before they are tied over the skin. A hemostat is placed on the free ends of each suture after it has been passed out through the tissues. The hemostats keep the suture flat so that the ends will not be in the way during the closure of the fascia and skin.

Interrupted sutures of the desired type and size are prepared for approximation of the muscle, if it is to be sutured, and for closure of the anterior rectus sheath (Fig. 165) The scrubbed nurse should secure one suture in the needle holder and should have two other sutures ready.

After the peritoneum and posterior sheath have been closed, the fascia and subcutaneous tissue are retracted, using Roux or small Richardson retractors.

The rectus muscle may be approximated. If it has been drawn aside, as a whole, it is not sutured. The anterior rectus sheath is closed, using interrupted sutures; then the skin towels and towel forceps are removed and discarded in the basin designated for this purpose (Figs. 279 and 280). During the closure of the fascia the scrubbed nurse assembles the pieces of equipment for terminal sterilization and places the dressing set on the Mayo stand.

The wound edges are cleansed, fresh towels are placed around the wound, and tension sutures are inserted, if used. In some patients these sutures are inserted before the rectus sheath is closed. The skin edges are approximated, the tension sutures tied, and the free ends cut (Fig. 281). Suitable dressings are secured over the wound surfaces.

REPAIR OF HERNIAS

General Considerations.—A hernia is a protrusion of any viscus or tissue through a weak spot or through an abdominal opening. The term hernia usually is applied to protrusion of abdominal viscera. Hernias are classified according to their anatomic situations, as inguinal, femoral, umbilical, lumbar, incisional, diaphragmatic, and sciatic.[19-24]

Surgical Anatomy.—The sac is a complete peritoneal pouch, which may be congenital or acquired.[12,25,26] If the contents are not adherent to the sac, they will withdraw freely into the peritoneum, but the sac remains in the abdominal wall. In a diaphragmatic hernia, a sac may or may not be present.

Incarcerated hernia is a hernia that cannot be reduced; the condition is generally due to adhesions between the contents of the hernial sac and the inner lining of the sac or adhesions between the contents themselves, or due to a narrowing of the neck of the sac. These conditions prevent the return of the hernia's contents into the abdomen.

Strangulated hernia is a hernia in which the contents are irreducible (incarcerated) and, furthermore, their circulation is impaired.[22]

The contents of the sac may contain parts of the viscera, such as the omentum, loops of small or large intestine, appendix, or a Fallopian tube. The anatomic situation of the hernia will in part determine its possible contents.

The coverings of the hernial sac vary. In acute cases of herniation the intestines may be pushed through the separated muscles with little covering except the peritoneum and skin. In the congenital type the sac, as it progresses through the abdominal wall, acquires a series of thin coverings, each one representing a layer of that wall.[22, 24, 25]

Repair of Inguinal Hernia (Direct or Indirect)

Definition.—Reconstruction of a weak spot in the abdominal wall, and repair of the protruding tissue in the opening, if necessary.

Surgical Anatomy.—The inguinal canal is a short diagonal pathway through the lower abdominal muscles (Figs. 264 and 265) The canal begins at the internal ring and ends at the external ring (Fig. 282). It contains the spermatic cord in the male or the round ligament in the female. The cord or round liga-

ment emerges from the abdomen through the transversalis fascia, at the internal inguinal ring, and then passes down between the internal oblique muscles and the external oblique aponeurosis to emerge near the spine of the pubis through the external ring.

The internal ring is an oval opening in the transversalis fascia.[21-26] It is located midway between the anterior superior spine and the pubis (Fig. 282)

The external ring is formed by the division of the external oblique aponeurosis near the pubic bone (Fig. 282). The upper part is attached to the

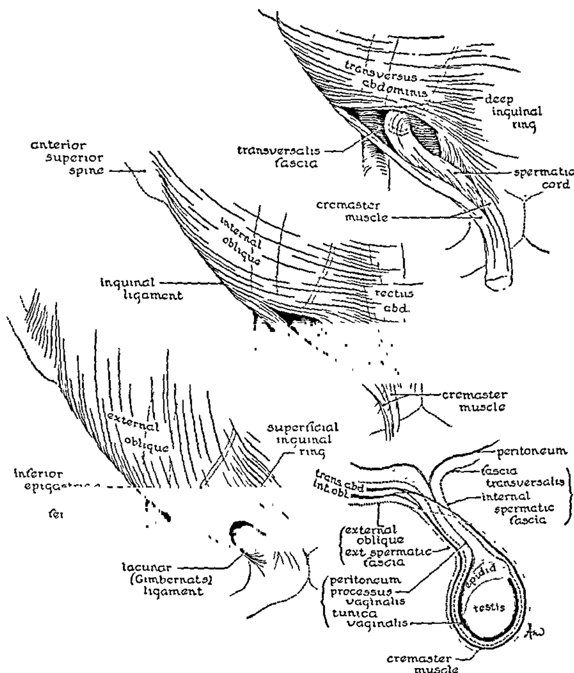


Fig 282 – Anatomy of inguinal canal is shown (From Moseley, H F Textbook of Surgery, St. Louis, 1955, The C V Mosby Co)

crest of the symphysis pubis and the lower to the spine of the pubis where it meets the attachments of the ilioinguinal (Poupart's) ligament.

The following organs and tissue may be involved during the repair of an inguinal hernia: inguinal nerves, cord structures, contents of the sac, femoral or epigastric vessels, and bladder.

An indirect inguinal hernia enters the inguinal canal through the internal ring, emerging at the external ring.

A direct inguinal hernia does not enter the canal through the internal ring, but protrudes directly through the transversalis fascia below the deep epigastric vessels, emerging at the external inguinal ring.[22,25-27]

Setup, Position, Skin Preparation, and Draping Procedure.—As for opening and closing a celiotomy, using a McBurney approach. The size of the instruments, draping sheets, sponges, and sutures will depend upon the age of the patient. In children and newborn infants, mosquito (Halsted) and Kelly hemo-

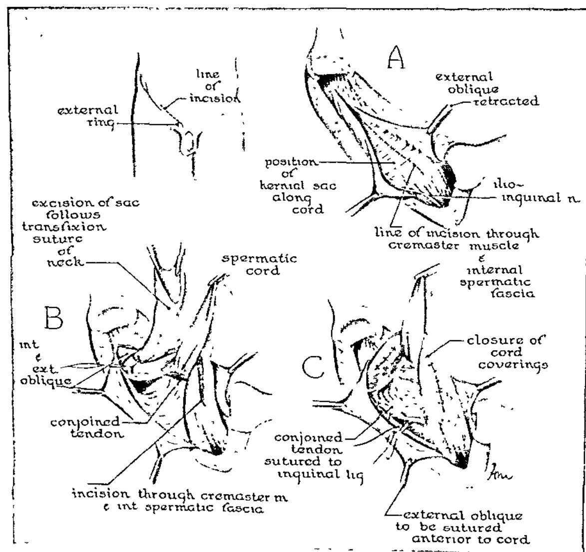


Fig 283—*A,B*, Repair of inguinal hernia, following the Bassini technique. *C*, The conjoined tendon is sutured to the inguinal ligament under the cord (From Moseley, H F.: Textbook of Surgery, St Louis, 1955, The C V. Mosby Co)

stats and slender retractors will be needed.[3,17] Suture may include chromic gut (medium) No. 3-0, 2-0, or 0, silk No. 3-0 to 0, cotton No. 2-0 to 0, stainless steel wire No. 5-0 to 3-0, or tantalum wire of the desired gauge. To repair some defects tantalum gauze and sutures or stainless steel wire mesh and sutures *may be required* (*Chapter 5*).

The patient is placed on the operating table in a supine position (Chapter 4). The prepared abdominal and pubic surfaces are draped with towels. The first two towels are placed obliquely at the top and lower end of the proposed line of incision (Fig. 283). The first towel should cover the region of Poupart's ligament; the second towel should be parallel to the first towel. The third and fourth towels are placed on each side of the proposed incision and parallel to each other. A laparotomy sheet is draped over the patient (Chapter 4).

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. An incision about 4 inches long is made a fingerbreadth above and parallel to Poupart's ligament. The surgeon protects his gloved hands from contaminants on the skin area by using opened gauze sponges.	1. Compresses, scalpel, tissue forceps, sponges, Crile or Kelly hemostats, basin for soiled instruments, as for opening a celiotomy
2. The bleeding vessels are clamped and ligated.	2. Surgical gut chromic No. 3-0 or 2-0.
3 Skin towels are applied, everting the skin edges. Fascia of the external oblique is exposed.	3. Towels, towel forceps, tissue forceps as described for celiotomy opening, Roux retractors, sponges, Crile hemostats
4. The external oblique fascia is opened in line with its fibers through the midpoint of the external inguinal ring.	4. Clean scalpel, 2 tissue forceps, sponges, Crile hemostats
5. Fascial edges are retracted so as to expose the conjoined tendon, rectus muscle, and Poupart's ligament.	5. Compresses, McBurney retractors, Metzenbaum scissors, tissue forceps, Crile hemostats
6. The two nerves, ilioinguinal and iliohypogastric, are exposed and protected.	6. McBurney retractors, tissue forceps without teeth
7. Cremasteric fascia is incised, exposing the elements of the cord. The cord is freed from the pubis to the internal abdominal ring	7 Scalpel or Metzenbaum scissors, opened gauze, gauze sponges, curved scissors

Now the nature of the hernia is determined; bulging peritoneum beneath the cord indicates a direct hernia; peritoneum protruding along the cord indicates an indirect inguinal hernia.

Steps	*Items*
8. If direct, the peritoneum bulging through the muscle is exposed.	8. McBurney retractors, moist open gauze sponges

In the direct hernia, if the sac is small, the surgeon may suture the transversalis fascia without excising the sac.

Steps	*Items*
9. In an indirect hernia, the cremasteric muscle is incised and the cord is elevated.	9. Penrose tubing for retraction of cord, hemostat
10. The hernial sac is exposed and freed from the cord to the internal ring.	10. Crile hemostats, tissue forceps with and without teeth, gauze sponges, curved Metzenbaum scissors
11. The sac is incised, and contents are pushed into the abdominal cavity.	11. Scalpel, Crile or mosquito hemostats, sponges on holders
12. The neck of the sac is transfixed and doubly ligated, and the sac excised	12. Tissue forceps, chromic gut No. 0, silk No. 2-0, or cotton No. 0 threaded on Murphy needle No. 3 on needle holder; sometimes a free ligature is used, curved scissors

The Bassini or Halsted method of repair (Fig. 283) or a modification is carried out as follows:

Steps	*Items*
13. The conjoined tendon and the internal oblique and transversalis muscles are sutured to Poupart's ligament behind the cord. The last stitch is placed deeply in the tissues near the pubic spine. The posterior inguinal walls may be repaired with tantalum or stainless steel mesh (Fig. 120). In a female patient, the operation is simplified since the wound ligaments are small and do not need to be transplanted to secure a firm repair [14,15,19,20,23]	13. McBurney or Roux retractors, 4 interrupted sutures of chromic gut No. 0 or 1 or silk or cotton No. 2-0 or 3-0, 12 inches, and threaded on Mayo needles No. 4; the wire mesh and sutures made of tantalum or stainless steel prepared as described in Chapter 5; needle holders, tissue forceps, wire scissors, Mayo needles Nos. 4 and 5, ½-circle, taper-point (Chapter 5)
14 All sutures are tied and cut. Traction rubber tubing or cotton tape is removed from the cord, thereby permitting it to drop into its bed. The external oblique muscle is sutured Skin towels and towel forceps are removed from the wound and are discarded in the basin in the sterile field. Two fresh towels are placed along the edges of the wound.	14. Straight scissors, tissue forceps without teeth, sponges, Roux retractors, interrupted sutures of chromic gut No. 2-0, or silk No. 3-0 or 2-0, threaded or swaged-on Mayo or Murphy needles, 2 needle holders, tissue forceps with teeth, scissors; basin near wound for towels, 2 fresh towels, gauze sponges

stats and slender retractors will be needed.[3,17] Suture may include chromic gut (medium) No. 3-0, 2-0, or 0, silk No. 3-0 to 0, cotton No. 2-0 to 0, stainless steel wire No. 5-0 to 3-0, or tantalum wire of the desired gauge. To repair some defects tantalum gauze and sutures or stainless steel wire mesh and sutures may be required (Chapter 5).

The patient is placed on the operating table in a supine position (Chapter 4). The prepared abdominal and pubic surfaces are draped with towels. The first two towels are placed obliquely at the top and lower end of the proposed line of incision (Fig 283). The first towel should cover the region of Poupart's ligament; the second towel should be parallel to the first towel. The third and fourth towels are placed on each side of the proposed incision and parallel to each other. A laparotomy sheet is draped over the patient (Chapter 4).

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. An incision about 4 inches long is made a fingerbreadth above and parallel to Poupart's ligament. The surgeon protects his gloved hands from contaminants on the skin area by using opened gauze sponges.	1. Compresses, scalpel, tissue forceps, sponges, Crile or Kelly hemostats, basin for soiled instruments, as for opening a celiotomy
2. The bleeding vessels are clamped and ligated	2. Surgical gut chromic No. 3-0 or 2-0.
3. Skin towels are applied, everting the skin edges. Fascia of the external oblique is exposed.	3. Towels, towel forceps, tissue forceps as described for celiotomy opening, Roux retractors, sponges, Crile hemostats
4 The external oblique fascia is opened in line with its fibers through the midpoint of the external inguinal ring.	4. Clean scalpel, 2 tissue forceps, sponges, Crile hemostats
5 Fascial edges are retracted so as to expose the conjoined tendon, rectus muscle, and Poupart's ligament.	5. Compresses, McBurney retractors, Metzenbaum scissors, tissue forceps, Crile hemostats
6. The two nerves, ilioinguinal and iliohypogastric, are exposed and protected.	6 McBurney retractors, tissue forceps without teeth
7. Cremasteric fascia is incised, exposing the elements of the cord The cord is freed from the pubis to the internal abdominal ring	7. Scalpel or Metzenbaum scissors, opened gauze, gauze sponges, curved scissors

Now the nature of the hernia is determined; bulging peritoneum beneath the cord indicates a direct hernia; peritoneum protruding along the cord indicates an indirect inguinal hernia.

The patient is placed on the operating table in a supine position (Chapter 4). To reduce strain on the pubic region, the knees are slightly flexed and supported by a small pillow. Routine skin preparation is carried out by the surgeon (Chapter 3). The patient is draped as for a celiotomy as shown in Chapter 4 (Figs. 89 to 94).

Operative Procedure.—The items used are the same as those used to repair an inguinal hernia, described previously in this chapter (Fig. 284). When the repair is to be done from below, a vertical incision is made through the tissues overlying the sac, and if from above, the incision is made as described for inguinal hernia repair. The sac is dissected and ligated as shown in Fig. 284, and the wound is closed in layers as described for wound closure in repair of an inguinal hernia.

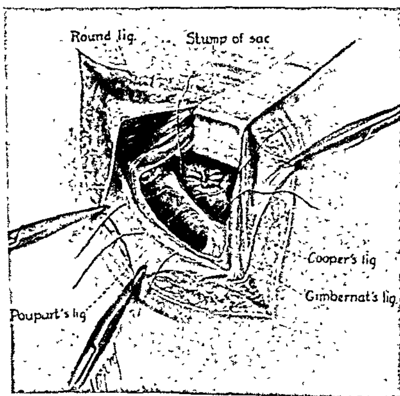


Fig 284 —Inguinal operation for femoral hernia, showing the ligation of the neck of the sac, Cooper's ligament, and the suturing of the femoral ring (From Watson, L. F.: Hernia, St. Louis, 1948, The C V Mosby Co)

Repair of Sliding Hernia

Definition.—To free the visceral contents and to repair the abdominal tissues surrounding and overlying the inguinal canal.

Considerations.—The term sliding hernia indicates that as the peritoneum slides into the internal ring it carries with it mesentery and bowel. If the hernia is on the right side, mesentery carries with it a loop of cecum, or if on the left side, a loop of sigmoid colon (Figs. 288 and 336). In such cases, some of the visceral contents of the hernia lie outside of the sac wall and are not covered by peritoneum.

Steps	*Items*
15. The subcutaneous tissue is closed. The skin edges are approximated, and the wound is dressed. The patient is moved gently from the operating table to his bed or stretcher.	15. Interrupted sutures of chromic or plain gut or silk No. 3-0, threaded on Murphy needle No 3, needle holders, tissue forceps, scissors, interrupted sutures of silk No. 4-0 or nylon No. 5-0 threaded on straight skin needles, straight hemostat, tissue forceps with teeth and tissue forceps without teeth; gauze compresses 4 by 8 inches or other type of dressing preferred

Plan Used for Repair of Bilateral Hernia.—Two sterile setups, or one setup with additional dissecting instruments, towel forceps, basin set, gloves, and laparotomy sheet may be used.

When two setups have been prepared, a separate setup is used to repair the hernia on each side.

The arrangement of the instruments on the portable stand depends upon which side is to be repaired at this time. After completion of the first operation, the soiled sheets are removed from the patient, and the skin area of the opposite side is prepared. The scrubbed team members change their gowns and gloves. The patient is draped in the routine manner.

When a single setup is used for repair of the right and left hernia, the scrubbed nurse prepares the portable stand as described for a gastrointestinal operation (Chapter 12). After completion of the hernial repair on one side, the scrubbed nurse discards all items used in closing the subcutaneous tissue and skin edges. The laparotomy sheet on the patient and uppermost towels on the portable stand are removed. The operative skin area on the other side is painted with a germicide, and the patient is draped with a fenestrated sheet. The scrubbed members of the team change their gowns and gloves The scrubbed nurse arranges the additional instruments on the portable stand for repair of the hernia on the other side.

Repair of Femoral Hernia

Definition.—To remove and replace peritoneum protruding through the femoral ring which is situated just below the Poupart ligament and alongside the femoral vein; to repair the abdominal wall surrounding the opening.

Considerations.—A femoral hernia is found more frequently in women than in men, and is seldom found in children. When present in adults it may be unilateral or bilateral.[22,24-26]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as listed for opening a celiotomy through a McBurney approach, plus the following:

2 Intestinal forceps, small size
6 Kelly hemostats, curved
2 Babcock forceps

Repair of Diaphragmatic Hernia

Definition.—To replace the abdominal contents which have entered the thorax and to repair the defect in the diaphragm.

Considerations.—Diaphragmatic hernias may be classified in three groups: congenital, acquired, and traumatic types. Such hernias may occur at the esophageal, parasternal, paravertical, central, lateral, or posterior openings. The contents protruding through the opening may be stomach, small intestine, omentum, liver, spleen, pancreas, colon, or kidney. A loop of bowel may become obstructed or strangulated. The hernia may or may not have a sac.[22-28]

Setup, Position, Skin Preparation, and Draping Procedure.—The items include the following:

1 Major celiotomy setup, plus gastrointestinal instruments for resection of bowel (Chapter 12)
1 Tissue forceps, 1 and 2 teeth, 7 inches
1 Tissue forceps without teeth, 7 inches
2 Deaver retractors, desired size
1 Adson suction tube and rubber suction tubing

For a thoracicoabdominal approach, add:
1 Chest retractor, self-retaining
1 Cartilage scissors
1 Periosteal elevator

The patient is placed on the operating table in a position that will provide for safety and exposure of the proposed operative site (Chapter 4). Routine skin preparation is carried out (Chapter 3), and the patient is draped with a fenestrated laparotomy or chest sheet (Chapter 4).

Operative Procedure.—In general, the major steps and items include the following:

Steps	*Items*
1. The location and type of incision will depend upon the location of the hernia. A paramedian, subcostal, or thoracicoabdominal approach may be used (Figs 267, 268, 272, or 273). An abdominal approach is usually preferred for parasternal or for an esophageal hiatus hernia.	1. As described for celiotomy; for a thoracicoabdominal approach, heavy scissors, periosteal elevators, chest retractor, large pads moistened with saline solution
2. The sac, if present, is freed from the surrounding tissues. Strangulated loop of bowel or redundant omentum may be resected. The sac is ligated and amputated.	2. Tissue forceps, scissors, large pads, long scissors, sponges on holders, suction set, gastrointestinal setup, silk No. 2-0 or 3-0 or chromic gut No. 0
3. The abdominal viscera are returned to the abdominal cavity. The defect in the diaphragm or abdominal wall is closed with mattress sutures (Fig. 121).	3. Sponges on holders, interrupted sutures of silk No. 3-0 or chromic gut No. 9 threaded on Mayo or Murphy needles, 2 needle holders, tissue forceps and scissors
4. The abdominal or chest wound is closed in layers without drainage (Figs. 274 to 278).	4. As described for closure of the abdominal wall or chest wall (Chapter 9)

Setup, Position, Skin Preparation, and Draping Procedure.—The items include the following:

A major celiotomy setup, plus
6 Crile hemostats, straight
2 Babcock forceps
2 Interstinal forceps
3 Intestinal sutures
Tantalum or stainless steel sutures, if desired

The patient is placed on the operating table in a supine position (Chapter 4). Routine skin preparation is done (Chapter 3). The patient is draped as described for a celiotomy (Chapter 4).

Operative Procedure.—The major steps include the following:

Steps	*Items*
1. An incision is made in the inguinal region.	1. As described for incisional approach to repair an inguinal hernia
2. The sac is widely opened to permit the freeing of the internal ring.	2. Tissue forceps, scalpel, Metzenbaum scissors, moist gauze sponges
3 The adherent bowel is dissected free, replaced with the abdominal cavity, and the peritoneum closed.	3. Babcock and Allis forceps, laparotomy pads, scissors, fine ligatures and sutures, hemostats, deep retractors
4. A portion of the sac may be excised. The neck is closed with interrupted sutures or a continuous suture (Fig. 121).	4. As described in Steps 11 and 12 to repair an inguinal hernia
5. Hernial repair is done.	5. As described in Steps 13 and 14 for wound closure in repair of an inguinal hernia

Repair of Epigastric Hernia

Definition.—Repair of abdominal wall in the epigastric region.

Considerations.—An epigastric hernia is a small hernia occurring in the midline, generally above the umbilicus (Figs 263 and 264). There is rarely a large hernial sac If a large ventral hernia is present, it is usually found at the midline due to a separation of the recti muscles (Fig. 265)

Setup, Position, Skin Preparation, and Draping Procedure.—As described for opening and closing in a celiotomy through a paramedian approach, plus sutures as for repair of inguinal hernia.

Operative Procedure.—The abdominal wall is opened to expose the hernia, as described for the McBurney approach.

If a small sac is present, it is ligated as described for repair of an inguinal hernia If a large ventral hernia is present, the sac may be dealt with as described for repair of an umbilical hernia (Fig 285) Closure is effected by overlapping the recti sheaths or by freeing and approximating the recti muscles in the midline The wound is closed in layers as described for closure of a celiotomy.

Repair of Diaphragmatic Hernia

Definition.—To replace the abdominal contents which have entered the thorax and to repair the defect in the diaphragm.

Considerations.—Diaphragmatic hernias may be classified in three groups: congenital, acquired, and traumatic types. Such hernias may occur at the esophageal, parasternal, paravertical, central, lateral, or posterior openings. The contents protruding through the opening may be stomach, small intestine, omentum, liver, spleen, pancreas, colon, or kidney. A loop of bowel may become obstructed or strangulated. The hernia may or may not have a sac.[22-28]

Setup, Position, Skin Preparation, and Draping Procedure.—The items include the following:

1 Major celiotomy setup, plus gastrointestinal instruments for resection of bowel (Chapter 12)
1 Tissue forceps, 1 and 2 teeth, 7 inches
1 Tissue forceps without teeth, 7 inches
2 Deaver retractors, desired size
1 Adson suction tube and rubber suction tubing

For a thoracicoabdominal approach, add:
1 Chest retractor, self-retaining
1 Cartilage scissors
1 Periosteal elevator

The patient is placed on the operating table in a position that will provide for safety and exposure of the proposed operative site (Chapter 4). Routine skin preparation is carried out (Chapter 3), and the patient is draped with a fenestrated laparotomy or chest sheet (Chapter 4).

Operative Procedure.—In general, the major steps and items include the following:

Steps	*Items*
1. The location and type of incision will depend upon the location of the hernia A paramedian, subcostal, or thoracicoabdominal approach may be used (Figs 267, 268, 272, or 273). An abdominal approach is usually preferred for parasternal or for an esophageal hiatus hernia.	1. As described for celiotomy; for a thoracicoabdominal approach, heavy scissors, periosteal elevators, chest retractor, large pads moistened with saline solution
2. The sac, if present, is freed from the surrounding tissues. Strangulated loop of bowel or redundant omentum may be resected. The sac is ligated and amputated.	2. Tissue forceps, scissors, large pads, long scissors, sponges on holders, suction set, gastrointestinal setup, silk No. 2-0 or 3-0 or chromic gut No. 0
3. The abdominal viscera are returned to the abdominal cavity. The defect in the diaphragm or abdominal wall is closed with mattress sutures (Fig. 121).	3. Sponges on holders, interrupted sutures of silk No. 3-0 or chromic gut No. 9 threaded on Mayo or Murphy needles, 2 needle holders, tissue forceps and scissors
4. The abdominal or chest wound is closed in layers without drainage (Figs. 274 to 278).	4 As described for closure of the abdominal wall or chest wall (Chapter 9)

Setup, Position, Skin Preparation, and Draping Procedure.—The items include the following:

A major celiotomy setup, plus
6 Crile hemostats, straight
2 Babcock forceps
2 Interstinal forceps
3 Intestinal sutures
Tantalum or stainless steel sutures, if desired

The patient is placed on the operating table in a supine position (Chapter 4). Routine skin preparation is done (Chapter 3). The patient is draped as described for a celiotomy (Chapter 4).

Operative Procedure.—The major steps include the following:

Steps	*Items*
1 An incision is made in the inguinal region.	1. As described for incisional approach to repair an inguinal hernia
2. The sac is widely opened to permit the freeing of the internal ring.	2. Tissue forceps, scalpel, Metzenbaum scissors, moist gauze sponges
3. The adherent bowel is dissected free, replaced with the abdominal cavity, and the peritoneum closed.	3. Babcock and Allis forceps, laparotomy pads, scissors, fine ligatures and sutures, hemostats, deep retractors
4. A portion of the sac may be excised. The neck is closed with interrupted sutures or a continuous suture (Fig. 121).	4. As described in Steps 11 and 12 to repair an inguinal hernia
5. Hernial repair is done.	5. As described in Steps 13 and 14 for wound closure in repair of an inguinal hernia

Repair of Epigastric Hernia

Definition.—Repair of abdominal wall in the epigastric region.

Considerations.—An epigastric hernia is a small hernia occurring in the midline, generally above the umbilicus (Figs. 263 and 264). There is rarely a large hernial sac If a large ventral hernia is present, it is usually found at the midline due to a separation of the recti muscles (Fig. 265).

Setup, Position, Skin Preparation, and Draping Procedure.—As described for opening and closing in a celiotomy through a paramedian approach, plus sutures as for repair of inguinal hernia.

Operative Procedure.—The abdominal wall is opened to expose the hernia, as described for the McBurney approach.

If a small sac is present, it is ligated as described for repair of an inguinal hernia. If a large ventral hernia is present, the sac may be dealt with as described for repair of an umbilical hernia (Fig 285). Closure is effected by overlapping the recti sheaths or by freeing and approximating the recti muscles in the midline. The wound is closed in layers as described for closure of a celiotomy.

Steps	*Items*
8. The lower edge of the upper flap of the rectus sheath is sutured to the outer surface of the lower flap or vice versa. The skin edges are closed, and the wound dressed.	8. Interrupted sutures of chromic gut No. 2-0 or stainless steel wire No. 4-0, hemostats, needle holders, tissue forceps, scissors, silk No. 4-0 or nylon No. 5-0 threaded on straight or ⅜-circle skin needles; dressings

Repair of Incisional Hernia

Definition.—Suturing together the abdominal muscles and fascia at the hernial site.

Considerations.—Incisional or postoperative hernia is a separation of the abdominal wall. There are many possible reasons for its occurrence: excessive postoperative strain on part of the patient, the presence of a hematoma, infection, poor selection of suture material, or delayed wound healing.

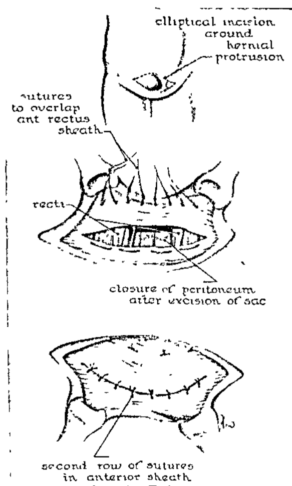


Fig 285.—Mayo closure is shown for umbilical hernia. After the peritoneum is closed transversely and the ring is enlarged by incision of the rectus muscles on each side, the imbricating upper flap is closed over the lower flap with sutures inserted closely together. The subcutaneous tissue and skin edges are approximated (From Moseley, H F.. Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co)

Repair of Umbilical Hernia

Definition.—Closure of peritoneal opening, and reconstruction of abdominal wall surrounding umbilicus.

Considerations.—An umbilical hernia is a protrusion of the peritoneum through the umbilical ring, which normally closes after birth, due to fusion of the skin with the superficial fascia, transversalis fascia, and peritoneum in this area (Figs. 264 and 265).

Setup, Position, Skin Preparation, and Draping Procedure.—The items include the following:

Major celiotomy setup—size of items suitable to patient (child or adult)
2 Intestinal resection clamps
4 Babcock or Allis-Adair forceps
6 Kelly or mosquito forceps, curved
2 Intestinal sutures, chromic gut No. 2-0 swaged-on needle
2 Silk sutures Nos. 3-0 and 4-0 swaged-on needles

The patient is placed on the operating table in a supine position (Chapter 4). The shoulders may be elevated with a thin sponge-rubber pad and the pelvic region slightly elevated. The knees should be flexed and supported by a proper-sized pad or pillow to relieve body strain and make it easier for the surgeon to approximate the wound layers. Routine skin preparation and draping procedure for a celiotomy are carried out (Chapters 3 and 4).

Operative Procedure.—The steps, as shown in Fig. 285, and items include the following:

Steps	*Items*
1-5. An elliptical, vertical, or transverse incision is made about the hernia. The incision is made down to the aponeurosis encircling the umbilicus. Bleeding vessels are clamped and ligated (Fig. 285).	1-5. As described in Steps 1-5 for opening in a celiotomy
6. The peritoneum is separated from the fascial surface The sac and its contents are examined and reduced. In a strangulated hernia the incision is made down to the sac, which is opened, and the bowel is inspected. Resection of the intestine lying in the sac may be necessary	6. As described for repair of inguinal hernia. Gastrointestinal setup for resection of bowel (Chapter 12)
7. Peritoneal edges are closed with interrupted sutures Aponeurosis on each side of the umbilical ring is freed from the overlying fat, and the upper rectus sheath is closed. The rectus sheath is usually overlapped as shown in Fig. 285.	7. Interrupted sutures of chromic gut No. 2-0 or 3-0 threaded on Murphy needle No. 2 or 3, needle holders, tissue forceps, scissors, hemostats, dissecting scissors, Allis forceps

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as for repair of umbilical hernia. If fascia lata is to be taken from the patient's thigh, add the following items: regular sheets used for draping a leg (Chapter 17), fascial stripper, and dissecting instruments (Figs. 286 and 287). In some cases prepared fascia lata, tantalum, or stainless steel mesh and wire sutures may be preferred.[14,22,20]

The patient is placed on the operating table in a supine position. Routine skin preparation is carried out (Chapter 3). The patient is draped as for a celiotomy, and one leg draped with sheets if fascia lata is to be obtained (Chapters 4 and 17).

Operative Procedure.—The steps of the operation are similar to those described for repair of an umbilical hernia (Fig. 285). The repair, using fascia lata and overlapping the flaps, is carried out as shown in Figs. 286 and 287.

REFERENCES

1. Altmeir, W. A., and Stevenson, J M.: Physiology of Wound Healing; in Christopher, F.: Textbook of Surgery, ed 6, Philadelphia, 1956, W. B Saunders Co.
2. Anson, B. J.: An Atlas of Human Anatomy, Philadelphia, 1950, W. B Saunders Co
3. Gross, R E: The Surgery of Infancy and Childhood, Philadelphia, 1953, W. B. Saunders Co, chaps. 4, 30, 31, 32.
4. Lahey, F. H: Surgical Exposures, S. Clin North America 30:773, 1950
5. Lampe, E. W: Surgical Anatomy of the Abdominal Wall, S. Clin. North America 32:545, 1952.
6. Lichtenstein, M D: Abdominal Wall and Peritoneum; in Christopher, F.: Textbook of Surgery, ed 6, Philadelphia, 1956, W. B Saunders Co, chap. 18.
7. Lounsburg, B F Basic Principles of Techniques in Surgical Care; in Christopher, F.: Textbook of Surgery, ed 6, Philadelphia, 1956, W. B Saunders Co., chap 8
8. Maes, U, and Ilgenfritz, C Surgical Aseptic Technic; in Lewis' Practice of Surgery, Hagerstown, Md, 1955, W. F Prior Co, Inc, vol 1, p 20
9. Mersheimer, W L, and Winfield, J M: Abdominal Wound Disruption, a Review of the Etiology, Recognition and Management, S Clin North America 4:471, 1955.
10. Rawles, B W, Jr: Abdominal Incisions, in Horsley, G. W, and Bigger, I. A: Operative Surgery, ed 6, St Louis, 1953, The C V Mosby Co
11. Anson, B. J, and Maddock, W. G Callander's Surgical Anatomy, ed. 3, Philadelphia, 1952, W B Saunders Co, p 337.
12. Bickham Callander: Surgery of the Alimentary Tract, Shackelford, R T. (ed), Philadelphia, 1955, W. B Saunders Co, vol. 3, chaps 12, 13.
13. Wilder, J R: Atlas of General Surgery, St Louis, 1955, The C. V Mosby Co
14. Jones, T E, Newell, E T, and Brubaker, R E: The Use of Alloy Steel Wire in the Closure of Abdominal Wounds, Surg Gynec & Obst 72:1036, 1941
15. Koontz, A R Tissue Reactions to Tantalum Mesh and Wire, Ann. Surg. 131:666, 1950.
16. Coller, F A, and MacLean, K F, in Cole, W. H: Operative Technic in General Surgery, New York, 1949, Appleton Century-Crofts, Inc, pp 314-358.
17. Hopkirk, J R, and Long, R C Preoperative and Postoperative Care; in Moseley, R. F.: Textbook of Surgery, St Louis, 1953, The C V Mosby Co, chap 5
18. Sweet, R H: Thoracic Surgery, ed 2, Philadelphia, 1954, W. B Saunders Co, p. 71.
19. Iason, A H: Inguinal Hernia in Infants, GP 5:67, 71, May, 1952
20. Mair, G G.: Surgery of Abdominal Hernia, Baltimore, 1948, Williams & Wilkins Co
21. McVay, L, and Anson, B Inguinal and Femoral Hernioplasty, Surg Gynec. & Obst. 88:4731, 1949.

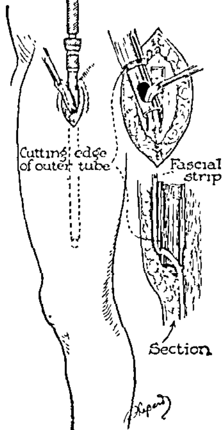


Fig. 286 —Method of securing fascia lata flaps with Masson's fascia stripper. (From Watson, L. F.: Hernia, St. Louis, 1948, The C V Mosby Co)



Fig. 287 —Hernia operation with fascia lata sutures Overlapping the fascial flaps Fine silk is used for the preliminary mattress sutures (From Watson, L. F : Hernia, St. Louis, 1948, The C V. Mosby Co)

CHAPTER 12

OPERATIONS ON THE ESOPHAGUS, STOMACH, DUODENUM, AND INTESTINES

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

Definition of Terms

Gastrointestinal tract usually refers to the stomach and the small and large intestines.[1-9] The word colon is generally applied to the entire large intestine, exclusive of the rectum. The alimentary canal comprises a series of organs which conform to a basic plan for supplying nourishment to the body and discharging wastes. The entire alimentary tract includes the mouth, the pharynx, the esophagus, the stomach, the small intestine (duodenum, jejunum, and ileum), the large intestine (cecum and colon), the rectum, and the anus.

Influence of the Nervous System on the Gastrointestinal Structures

The structural wall of the gastrointestinal tract is composed of four layers, except in the esophagus, which does not contain a serosal layer. The four layers from within outward include a mucosal layer containing villi, epithelial cells, and capillaries; a submucosal layer composed of loose connective tissue containing many blood and lymph vessels; a muscular layer composed of inner oblique, circular, and longitudinal fibers; and a serosal layer containing fibrous tissue and visceral peritoneum.[1, 4]

The progress of material through the gastrointestinal tract results from muscular activity of the organs. Such activity is influenced by the sympathetic and parasympathetic nerves (Chapter 6). The former reach through the splanchnic nerve, whereas the latter, which are derived from the medulla oblongata in the brain, pass through the vagus nerve that acts on the muscles of the stomach, small intestine, and the proximal half of the large intestine. Other parasympathetic nerves, which are derived from the sacral portions of the spinal cord, supply the lower half of the large intestine and the rectum. The results of studies seem to indicate that the parasympathetic nerves are excitatory for all musculature except the sphincters, for which they are generally inhibitory. On the other hand, the sympathetic nerves are excitatory for the sphincters and inhibitory for the other muscles Even though these two nerves are antagonistic within the gastrointestinal tract, muscular activity can occur without them, since a decentralized nervous system controls intestinal movements within the mucosal layer and between the muscular layers of the tract.[1, 2, 6]

22. McVay, L.: Hernia: Pathology, Anatomy, and Repair, Springfield, Ill, 1954, Charles C Thomas, Publisher.
23. McVay, L: Hernia; in Christopher, F.: Textbook of Surgery, ed. 6, Philadelphia, 1956, W. B Saunders Co, chap. 19.
24. Watson, L. F: Hernia, ed 3, St. Louis, 1948, The C V. Mosby Co.
25 Zimmerman, L. M., and Anson, B. J.: The Anatomy and Surgery of Hernia, Baltimore, 1953, Williams & Wilkins Co
26. Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C V. Mosby Co
27. Ochsner, A., and DeBakey, M. E, in Christopher, R. F.: Minor Surgery, ed. 7, Philadelphia, 1955, W. B Saunders Co., chaps 2, 3, 14.
28. Boyd, D.: The Transthoracic Repair of Esophageal Hiatus Hernia, S. Clin. North America 6.631, 1956.
29. Gallie, W. E, and Le Mesurier, A. G.: Living Sutures in Operative Surgery, Canad. M.A.J 11:504, 1921.

CHAPTER 12

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Definition of Terms

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Within the muscular layer of the tract the circular fibers are enlarged at points where one part of the tract joins the next. These junctions are known as sphincters because they keep the lumen of the tract closed until a stimulus causes them to relax. This action, which is controlled by the sympathetic excitatory nerves and by the parasympathetic (inhibitory) fibers, restrains the food units in their passage from one part of the tract to the next and also prevents regurgitation.[1, 5, 8] The terms used for the sphincters correspond to those portions which are involved. They are known as: (1) the cardia sphincter between the esophagus and body of the stomach, (2) the pyloric sphincter between the stomach and small intestine, (3) the ileocecal valve between the small and large intestine, and (4) the internal and external anal sphincter between the rectum and anal opening.

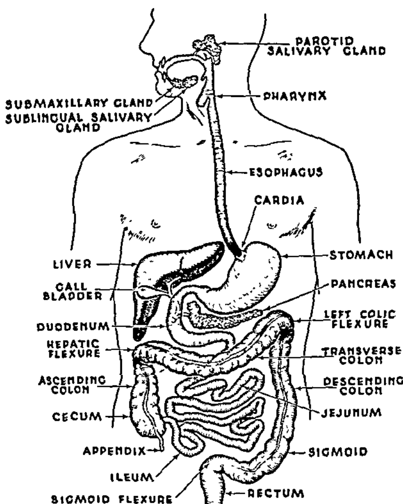


Fig 288 —The alimentary tube and its appendages (From Zoethout, W. D., and Tuttle, W. W: Textbook of Physiology, St Louis, 1955, The C V. Mosby Co)

Regional Anatomy of the Gastrointestinal Organs

The esophagus, extending from the pharynx at the level of the sixth cervical vertebra, passes through the posterior mediastinum, joins the cardia orifice of the stomach, and passes behind the aortic arch. Although the esophag-

cal wall does not contain a serosal layer, its layers can be anastomosed surgically because the mucosal layer is far stronger than the muscular layer.

The blood supply of the esophagus is segmental. The cervical portion is supplied by branches of the subclavian and inferior thyroid arteries; the intrathoracic portion is supplied by the thoracic aorta and the bronchial and intercostal arteries; and the lower portion is supplied by the aortic esophageal branches. The vagus and the phrenic thoracic nerves penetrate the esophagus.

The stomach is situated between the esophagus and the duodenum. It lies in the upper abdominal cavity, to the left of the midline, beneath the diaphragm. *The stomach is divided into three parts:* the fundus, the body, and the antrum (Figs. 292 and 293). The fundus lies beneath the left dome of the diaphragm behind the apex of the heart and pericardium at a level with the fifth rib posteriorly. The body and antrum of the stomach lie in an oblique direction within the abdominal cavity.

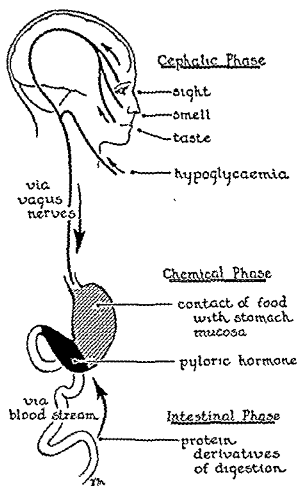


Fig 289—Mechanism of the stimulation of gastric secretion (From Moseley, H F: Textbook of Surgery, St. Louis, 1955, The C V. Mosby Co)

The stomach is stabilized indirectly by the lower portion of the esophagus and directly by its attachment to the duodenum, which is anchored to the posterior parietal peritoneum. It also is associated with the celiac vessels, the peritoneal ligaments, and the omenta, which also give it support.

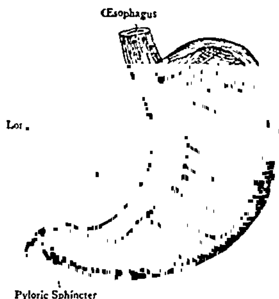


Fig 290—External view of the stomach after removal of the serous coat. Most of the longitudinal and much of the circular layer have been removed to show the oblique layer. (Buchanan) (From Zoethout, W. D, and Tuttle, W. W: Textbook of Physiology, St Louis, 1913, The C V. Mosby Co)

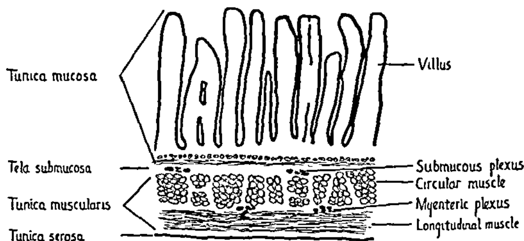


Fig 291—Longitudinal section of jejunum (From Francis, C C, Knowlton, G C, and Tuttle, W W Textbook of Anatomy and Physiology, St Louis, 1913, The C V. Mosby Co)

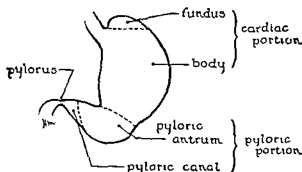


Fig 292—Regional anatomy of the stomach (From Moseley, F H. Textbook of Surgery, St Louis, 1955, The C V Mosby Co)

The convex or lower margin of the stomach is known as the greater curvature, and its concave margin is identified as the lesser curvature. Attached to the greater curvature is the greater omentum, through which runs the left gastroepiploic branch of the splenic artery and the right gastroepiploic branch of the hepatic artery. The splenic artery enters the stomach at the upper portion of the greater curvature. The lesser omentum, which is attached to the lesser curvature of the stomach, contains the left gastric artery, a branch of the celiac artery, and the right gastric branch of the hepatic artery. During a gastrectomy these vessels are clamped and ligated.[2, 3, 10-12] (Fig. 291.)

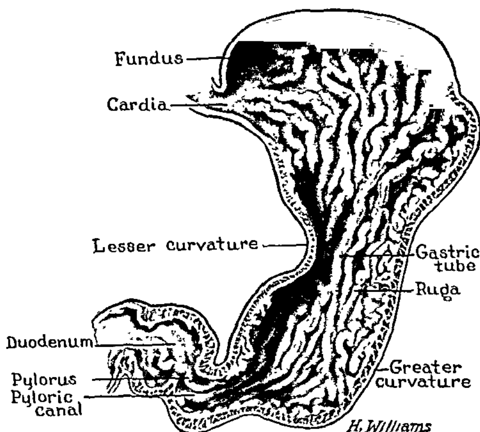


Fig 293—Frontal section of the stomach. (From Francis, C C, Knowlton, G C, and Tuttle W W Textbook of Anatomy and Physiology, St Louis, 1943, The C. V. Mosby Co)

The small intestine, which begins at the pylorus and ends at the ileocecal valve, is divided into three parts: the duodenum, about 1 foot long; the jejunum, 7½ feet long; and the ileum, 11½ feet long. The length of the small intestine varies with the degree to which the muscle fibers are contracted, but it is usually about 20 feet in length and 1 inch in diameter (Fig. 288).

The duodenum, the proximal portion of the small intestine, begins at the pyloric opening and is continuous with the jejunum below. It is stabilized by a fusion between the peritoneum and the head of the pancreas which is attached to the posterior parietal peritoneum. The duodenum communicates also with the common bile duct. The duodenojejunal angle is stabilized by

the ligament of Treitz that suspends the duodenum. An anastomosis between the stomach and jejunum is generally performed near the ligament of Treitz. The uppermost part of the duodenum forms the beginning of the C-shaped bend that encloses a portion of the pancreas, the pylorus, and the neck of the gall bladder.

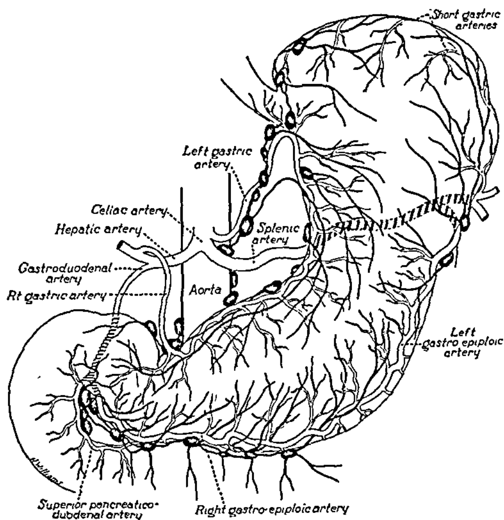


Fig 294—Arterial supply of the stomach (After Cutler and Zollinger; from Francis, C C, Knowlton, G C, and Tuttle, W W. Textbook of Anatomy and Physiology, St Louis, 1943, The C V. Mosby Co)

The descending portion of the duodenum forms an acute angle in its descent. It passes along the right side, then its inferior portion transverses to the left so that it lies in front of the right ureter, the inferior vena cava, and the aorta. It then turns upward and forward to become a part of the duodeno-jejunal flexure which, in turn, joins the jejunum. The bile duct and pancreatic ducts enter the descending portion of the duodenum. The blood supply of the duodenum comes from arterial branches of the celiac axis.

The jejunum, which is situated in the upper left portion of the abdominal cavity, joins the ileum, which is situated in the right lower portion of the

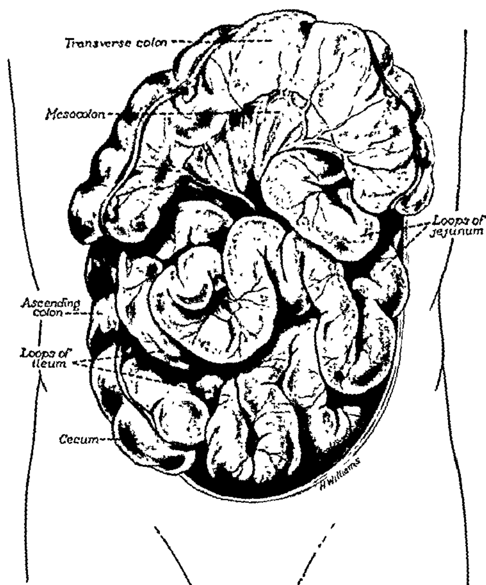


Fig 295 —Anterior view of the intestines The transverse colon has been turned upward to show the loops of jejunum (From Francis, C C Introduction to Human Anatomy, St Louis, 1949, The C V Mosby Co)

cavity. The ileum empties into the large intestine through the ileocecal valve. The jejunum and ileum are suspended by the mesentery, which is attached to the posterior abdominal wall. The free border of the mesentry, which is about 18 feet long, contains branches of the superior mesenteric artery, many veins, lymphatic nodes and vessels, and nerve fibers. The vessels of the jejunum are larger than those of the ileum (Figs. 295 and 296).

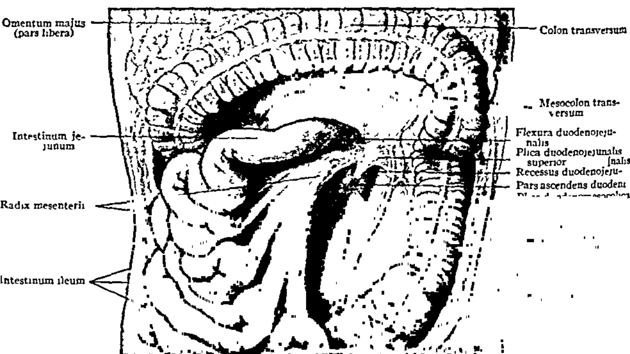


Fig 296 —The mesentery as seen when the intestine is pulled aside. (From Anson, B , and Maddock, W . Callander's Surgical Anatomy, Baltimore, 1950, W. B. Saunders Co)

STERILE ITEMS FOR GASTROINTESTINAL OPERATIONS

The pieces of equipment and dry goods needed for each type of operation should be standardized with the approval of the attending physicians. The preferences of each surgeon should be noted in the card file. Since it is frequently impossible for the surgeon to determine the kind of operation to be performed until after he has examined the involved organs, the setup should include those items which may be needed (Chapter 4)

Routine Setup

The items include the following·

Instruments

2 Greene retractors (Fig. 66)
2 Roux or Parker retractors
1 Pliable copper, ½ inch wide, 13-inch long retractor
2 Deaver retractors, wide and narrow blades
2 Richardson retractors, blade 1⅓ by 1½ inches
1 Doyen retractor (Fig. 297)
1 Balfour self-retaining retractor (Fig. 297)
2 Deschamp or Lahey ligature carriers
1 Trocar and cannula 18 F
2 Pool suction tips, with rubber tubing
1 Tonsil or Frazier suction tip

(Continued on page 458.)

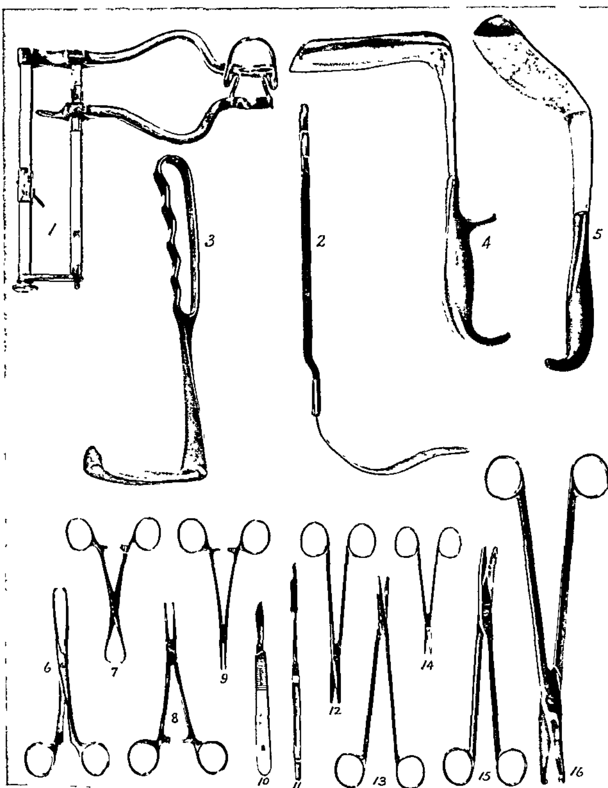


Fig. 297.—Instruments [illegible] ... scissors; 16, Heavy non-pointed blunt scissors.

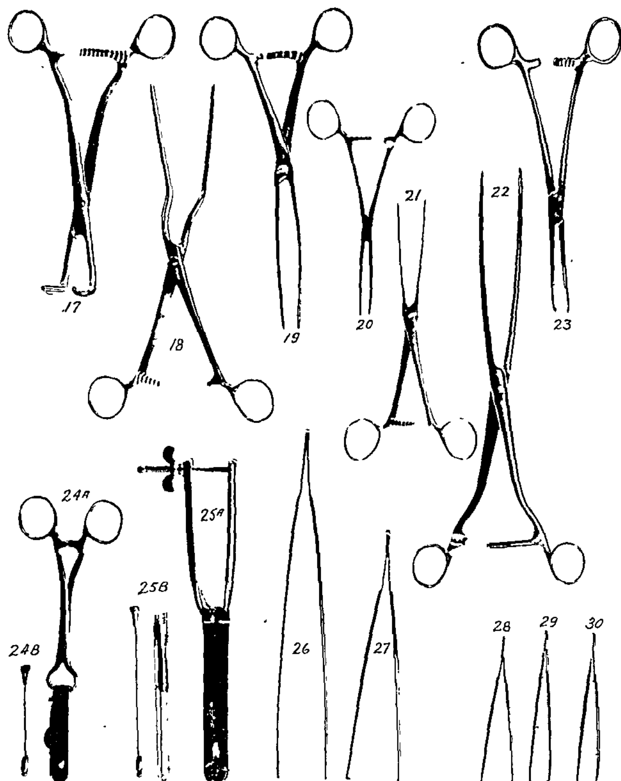


Fig 298.—Instruments for stomach and intestinal operations—cont'd: *17*, Mikulicz forceps, *18*, Brunner intestinal forceps, *19*, Doyen intestinal forceps, *20*, Scudder short intestinal forceps; *21*, Kocher intestinal forceps, *22*, Payr pylorus intestinal forceps, *23*, Mayo-Pean hemostat, 8 inches; *24A*, McClure modification of Furniss clamp, *24B*, McClure needle; *25A*, Furniss clamp; *25B*, metal needle and swaged-on straight intestinal needle and fine chromic gut; *26*, long tissue forceps without teeth; *27*, long tissue forceps with fine teeth, *28*, plastic tissue forceps without teeth; *29*, plastic tissue forceps with teeth, *30*, fixation plastic tissue forceps

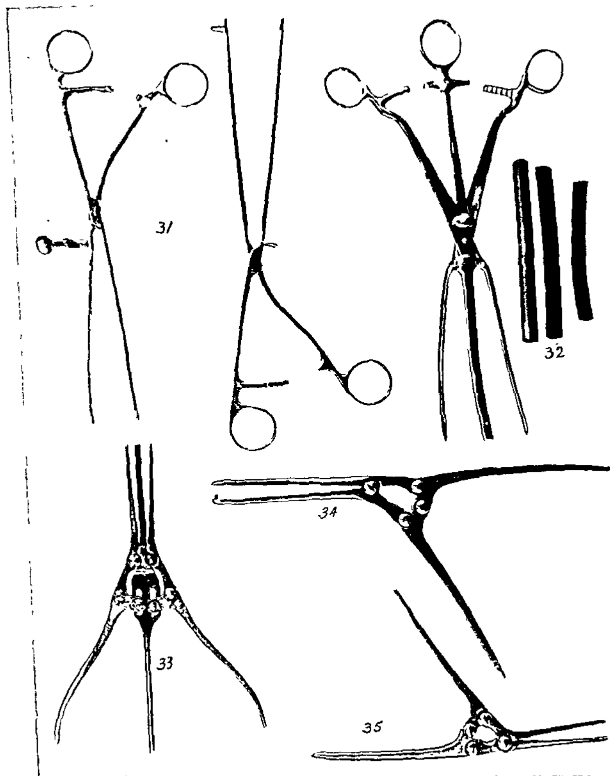


Fig 299 —Instruments for stomach and intestinal operations—cont'd· *31*, Lane gastroenterostomy forceps; *32*, Roosevelt gastroenterostomy forceps with rubber guards, *33*, Rankin intestinal clamp; *34*, Payr pylorus intestinal forceps, medium size; *35*, Payr intestinal forceps, small size.

3 Knife handles Nos. 4, 3, and 3 L, blades Nos. 20, 10, and 15
3 Kelly or Mayo tissue forceps, 2 and 3 teeth, 5½ inches
2 Kelly or Harrington forceps, 1 and 2 teeth, 7 inches
2 Bonney tissue forceps, 6 inches
3 Dressing forceps—2, 6 inches; 1, 10 inches
1 Tuttle, Russian, or Roberts forceps, 10 inches
16 Backhaus towel forceps
1 Probe, 7 inches
1 Grooved director
2 Nerve hooks, blunt, optional
2 Skin hooks
36 Crile hemostatic forceps, straight, 6¼ inches
8 Allis (4 and 5 teeth), Adair-Allis (9 and 10 teeth), or Lockwood-Allis forceps, 6¼ inches

Fig 300.—Allen anastomosis clamp, 8 inches, straight.

Fig. 301—Von Petz stomach and intestinal suturing apparatus, with clips (Courtesy Edward Weck & Co, Inc., Brooklyn, N. Y.)

1 Suture scissors
2 Mayo scissors, curved, 5¾ inches
1 Harrington, Nelson, or Sweet scissors, curved, 8 inches
1 Mayo scissors, straight, 7 inches
4 Mayo-Hegar needle holders—2, 6 inches; 1, 7 inches; and 1, 5 inches
4 Ballinger or Pean holding forceps
8 Foerster or Roberts holding forceps
6 Babcock forceps, 6¼ inches (Fig. 297)
12 Halsted hemostatic forceps, straight and curved, 5 inches (Fig. 297)
12 Kelly or Hopkins hemostatic forceps, straight, 5 inches
16 Mayo-Pean forceps, curved, 6¼ inches
4 Rochester-Ochsner forceps, curved, 8 or 9 inches

4 Ochsner or Kocher clamps, straight, 6¼ inches, if desired
2 Doyen intestinal forceps, or Scudder, desired length, and curved (Fig. 298)
2 Allen clamps
1 Asepto syringe
1 30 ml. syringe with adaptor
1 10 ml. syringe, needle gauge No. 20 or 18
2 Michel clip holders and clips, or autoclip holders and clips, optional

Suture Materials

1. Ligation of small arteries and veins: chromic surgical gut Nos. 4-0 and 3-0, or silk or cotton No. 5-0 or 4-0 (Chapter 5).
2. Ligation of large arteries: chromic surgical, medium, Nos. 0 and 1, or silk No. 2-0
3. Furniss clamp chromic gut No. 2-0 swaged-on curved intestinal needles
4. Anastomosis suture—chromic gut No. 2-0 or 3-0, 36 inches, swaged-on double-armed straight or curved needles
5. Closure of gastrointestinal layers: (1) mucosal layer—chromic gut, medium, No. 4-0 or 3-0, 36 inches, swaged-on fine intestinal needles; (2) muscularis layer and subserosal layer—interrupted suture of chromic gut, medium, No. 4-0, or silk No. 4-0 or 3-0 swaged-on intestinal curved needles; (3) serosal layer—silk No. 4-0 swaged-on curved or straight intestinal needles
6. Abdominal closure: (1) peritoneal layer—chromic gut No. 2-0 or 3-0 swaged-on needle, or Mayo ½-circle, taper-point No. 3 or 4; (2) fascial layers—chromic gut, medium, No. 0 or 2-0, or silk No. 3-0 swaged-on needle as for peritoneum; (3) skin—silk, nylon, or cotton, No. 5-0 or 4-0, or metal clips

Sutures described in Chapter 4

Drains

Pezzer catheter 18 F and stylet
Robinson catheter 24 F
Penrose rubber tubing ⅜-inch wide
Dakin rubber tubing 12 inches
2 Pieces of soft rubber tubing, narrow and medium diameter, each 12 inches
Rectal tube

Textiles

1 or 2 Major laparotomy packs, depending on method to be used
2 Gown sets
2 Glove sets
1 Tray pad
1 or 2 Laparotomy sheets
16 Large laparotomy pads
Plain gauze packing
Topper dressing pad
Small and large gauze sponges
Petrolatum gauze

Setups for Specific Operations

For some operations certain pieces of equipment can be omitted from or added to the routine gastrointestinal or the celiotomy setup (Chapter 11). The size of each piece of equipment, the type and size of draping sheets, operating table attachments, instruments, and sutures will depend on the age of the patient and the kind of incision to be made.

Esophageal Diverticulum.—Thyroidectomy setup (Chapter 7), plus the following:

Cushing bayonet forceps
Kelly hemostats
Nerve hooks
Nelson or Kahn dissecting scissors
Asepto syringe
Allis forceps
2 Rochester-Carmalt clamps

Esophagogastrostomy (Thoracicoabdominal).—Gastrointestinal setup, including the following:

Rib resection set (Chapter 9).
Chest retractor
Harrington or Nelson curved scissors, 9 inches
Umbilical tape
2 Best right-angled clamps, optional
1 Von Petz stomach clamp, or Payr clamp, 10 inches, for extreme resection (Figs. 299, 301)
Equipment for posterolateral position (Chapters 4, 9)
Regular sheets or fenestrated sheet (Chapter 4)

Gastrostomy and Gastrotomy.—Gastrointestinal setup, including Pezzer or Robinson catheter, 4-eyed, No. 20 or 22 F.

Gastrojejunostomy (Gastroenterostomy).—Gastrointestinal setup, including the following:

Roosevelt, Lane, Lennartz or Brunner intestinal clamps (Fig. 299)
Rankin clamps (Fig. 299)

Gastroduodenostomy.—As for gastrojejunostomy.

Gastrectomy (Partial).—Gastrointestinal setup, including:

2 Payr clamps, small, or
2 Allen or Ochsner clamps (Fig. 299)
2 Payr clamps, 10 inches, or
1 Von Petz stomach clamp (Fig. 301)
2 Scudder or Brunner intestinal clamps (Fig. 298)
1 Rankin or Furniss-Clute clamp with needle-suture (Fig. 298)
12 Extra Crile hemostats, straight, 6¼ inches
12 Extra Mayo-Pean hemostats, curved, 6¼ inches
Cautery or carbolic acid, 95 per cent, and alcohol, optional
Extra packs, large size

Gastrectomy (Total).—Partial gastrectomy setup, including the following:

2 Splanchnic retractors with narrow blades lighted, or
Cameron lights
Deaver retractor, wide blade with stockinet cover
2 Harrington clamps with angular jaws, 10 inches

Gastrojejunocolic Fistula Closure.—As for subtotal gastrectomy and colostomy setup.

Intestinal Resection.—As for partial gastrectomy, omitting Von Petz stomach clamps, Payr clamps, and extra hemostats.

Jejunostomy.—Basic major setup, plus the following:

2 Allen or Furniss-Clute forceps or 2 Payr clamps, 8 inches
2 Pezzer or Malecot catheters No. 20 or 24 F
Cautery, if desired

Meckel's Diverticulum.—As for intestinal resection.

Perforated Ulcer.—As for gastrostomy.

Pyloric Stenosis or Achalasia.—

2 Middledorph or Greene retractors
2 Parker 5¾ inches, or Farabeuf 5½ inches, double-ended retractors
2 Little retractors, blade ½ inch wide, 7½ inches
1 Flexible copper retractor with handle 1 inch wide
1 Director, curved
6 Backhaus or Jones forceps, 3 inches
6 Ballinger sponge-holding forceps, 7 inches
2 Frazier suction tips and tubing, medium and large sizes
4 Scalpel handles, Nos. 4 and 3
4 Blades—1, No. 20; 2, No. 10; 1, No. 15
2 Adson, Kelly, or Bonney tissue forceps
2 Tissue forceps, 1 and 2 teeth, 5½ inches
3 Tissue forceps without teeth and narrow tips—2, 4½; 1, 5½ inches
6 Allis intestinal forceps
4 Babcock intestinal forceps
24 Hopkins-Kelly hemostats, 5½ inches, straight and curved
6 Crile hemostats, straight, 5½ inches
12 Halsted hemostats, 5 inches, straight and curved
1 Catheter No. 8 or 10 F
1 Asepto syringe, 1 ounce
1 Suture scissors, straight, 5½ inches
2 Deaver or Mayo scissors, curved and straight
1 Metzenbaum scissors, curved, 5½ inches
1 Local set, Novocain solution, ½ per cent, if desired

Textiles

2 Small sheets or infant laparotomy sheet
Routine operating packs
Small laparotomy pads
Gauze compresses, 3 by 3 inches

Vagectomy.—As for partial gastrectomy, plus: nerve hooks, Frazier silver clips and holders. For transthoracic approach: rib resection set (Chapter 9). Posterolateral position and draping sheets (Chapters 4 and 9).

FACTORS RELATED TO MEDICAL ASEPSIS

Physiologic Consideration

In a healthy person, the stomach and duodenum are usually sterile except shortly after taking food, due to the disinfecting action of the hydrochloric acid in the gastric juice. Even though the stomach has some secretion of its own, it absorbs very little, except alcohol. In the duodenum and upper jejunum, the acidity of the gastric juice is neutralized by the alkaline substance of the pancreatic juice (Chapter 13). The ability of the gastric juice to control[1,2,4,6,11] pathogenic bacteria is reduced from above downward.

In the lower portion of the intestine a large number of bacteria are usually present in the material as it moves toward the ileum and colon. Certain kinds of cocci and clostridia are to be found in the cultures. Usually these pathogenic organisms are harmless in the intestine; however, if they enter the blood stream or peritoneal cavity, serious infection may result (Chapter 2).

The lymphatic system helps to carry away bacteria and their products. This explains why regional lymph nodes are enlarged in the presence of certain infections and lesions. Carcinoma in the colon is usually spread by means of the lymphatics or veins, which carry the cells to the liver, or the cancer cells

are spread directly. Cancer in the stomach spreads by direct extension into the stomach wall and its neighboring organs. It also spreads by means of the lymphatics and blood stream. The serous membranes (the peritoneum and omentum) help to prevent the spread of an infection due to their power to wall off a disease process.[1, 6]

The healing process of the sutured bowel depends largely on the serosa-to-serosa agglutination and normal healing of the wound (Chapter 5). Application of aseptic techniques helps to prevent pathogenic organisms from entering the blood stream or tissues by direct or indirect routes (Chapter 2).

Types of Anastomoses

The technique to be followed in gastrointestinal surgery depends on the location of the lesion and the type and characteristics of the disease.[2, 6, 10, 12-14]

The Terms

The septic or open anastomosis signifies that a portion of the gastrointestinal tract is openly divided and that the segments are openly sutured together in layers. In such cases the peritoneal cavity is exposed to the contents of the tract, a potentially "soiled" area. During the operation certain procedures are carried out to prevent the potential contaminants of the bowel from infecting the peritoneal cavity.

The aseptic or closed anastomosis implies that the gastrointestinal contents are confined by placing specific instruments on the involved segments before they are divided and a new passageway is established. Before the instruments are removed, the incised portions are closed by sutures. During the anastomosis the instruments which have been placed on the involved segments form a barrier that prevents the gastrointestinal contents from coming in direct contact with the open peritoneal cavity. The aseptic method decreases the possibility of infection, but it does not necessarily eliminate the danger.

Procedure for Using One or Two Sterile Setups

Two complete setups include the necessary gastrointestinal setup, and a celiotomy setup with sutures, gloves, gowns, basins, textiles, and furniture for each one. The gastrointestinal setup is used to open the abdomen, resect the diseased organs and re-establish continuity. The celiotomy setup is used to close the abdominal wound (Chapter 11).

During the preliminary preparation for the operation, the nursing team assembles both setups, ready for use. Two sets of gowns and gloves are arranged on a sterile table. The celiotomy setup is arranged on a sterile table and covered with a double-thickness sheet, then the gastrointestinal setup is prepared.

After completion of the anastomosis, all laparotomy pads are removed from the cavity, the wound is covered with a fresh moistened laparotomy pad, and the draping sheet is removed from the patient. The operators and scrubbed nurse change their gowns and gloves The circulating nurse assists in uncover-

ing the celiotomy setup. The patient is draped with a fenestrated sheet. The abdominal wound is closed (Chapter 11).

The use of two setups tends to reduce marginal errors of contamination and to simplify the nurses' duties.

The single setup, which is commonly used and generally preferred, comprises the desired gastrointestinal setup, with additional instruments, sutures, sponges, towels, basins, gowns and gloves for the wound closure, also a small metal tray and a small regular sheet.

During the preliminary preparation the scrubbed nurse drapes the portable stand in the routine way and covers it with a folded sheet and two towels. She takes a sponge-holding forceps and places the points beneath the folded sheet in an area on the stand nearest the instrument table. During the anastomosis, if necessary, the scrubbed nurse uses the forceps to transport an item from the instrument table to the portable stand.

Before the anastomosis is started the scrubbed nurse returns all unnecessary pieces of equipment from the portable stand to the instrument table. She also arranges on the portable stand the instruments, sutures, and sponges to be used for the resection and anastomosis. The lesion is mobilized; then the operative field surrounding the open wound is draped with large towels and the wound with four laparotomy pads. A small metal tray is placed on the sterile field near the lower end of the wound for soiled instruments and sponges.

After completion of the anastomosis the soiled pads and towels are removed from the wound (Chapter 4). The scrubbed nurse places the small tray with soiled instruments on the portable stand, grasps the uppermost corners of the sheet draped over the portable stand, and places the sheet containing the instruments in a large basin designated for this purpose. She then removes her soiled gown and gloves and dons fresh ones (Chapter 3). An assistant operator removes the skin towels and clips from the wound and discards them in the basin designated for this purpose. The operators remove their gowns and gloves and don fresh ones.

The scrubbed nurse or operator places a large fresh pad over the open wound and drapes the operative field with four towels. The scrubbed nurse assembles instruments and sutures on the portable stand for the wound closure (Chapter 11). When this plan is followed, the dangers of wound contamination are decreased, and fewer pieces of equipment are needed.

Precautionary Measures for Gastrointestinal Surgery

A systematic plan of work should provide safety for the patient who usually must undergo a long operation, involving multiple resections of several organs (Chapter 4). The plan should permit the nurses to work effectively with the other members of the operating team (Chapters 4 and 5).

The positioning of the patient on the operating table is an important aspect of his care since he must remain in the same position for a considerable period of time.[15, 16] The surgeon determines the position to be used. The selection depends on the incision to be made, the age and size of the patient, and the presence of other physicial handicaps (Chapter 4).

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begun, the clamp or clamps are placed on the involved segments, and moist gauze pads are placed around the instruments and the wound. The items used for the anastomosis are discarded, as previously mentioned.

POSITIONING THE PATIENT, SKIN PREPARATION, AND DRAPING PROCEDURE

Most patients are worried about having an operation, and frequently the patient with a gastric lesion is emotionally disturbed even though he may try to hide his real feelings.[15-19] The members of the nursing team should be free and ready to give the patient the reassurance that he needs. In accepting their responsibilities they can do much to provide for a "smooth" operation. If the patient is awake, the circulating nurse greets him by name and tells him she will help care for him while he is asleep. She checks his chart to make sure the operative permit has been signed and that the reports of tests, fluid intake and output, and the amount of retained gastric residue are recorded (Chapter 4).

The patient is placed on the operating table in a supine position (Chapter 4). His body must be kept in proper alignment to permit adequate circulatory and respiratory functioning and to relieve undue strain on muscles, nerves, and blood vessels.

To allow the stomach to drop below the costal margin, thereby reducing the fundus of the stomach, or to expose the cervical esophagus, the patient may be placed in reverse Trendelenburg position (Chapter 7). For an operation on the esophagus and stomach, the thoracicoabdominal approach may be used, and, if so, the patient is placed in a lateral position, with his left side uppermost (Chapters 4 and 9).

Routine skin preparation is carried out by the assistant operator as described in Chapter 3. The area includes the abdomen, from the nipple line down to the mid-thigh. If a thoracicoabdominal approach is to be used, the left posterior chest region is also prepared (Chapter 11). The proposed line of incision is surrounded by sterile towels and the patient covered with a laparotomy sheet (Chapters 4 and 11).

OPERATIONS

The nursing members of the operating teams should understand the definition, considerations, purposes, major steps of the operation to be performed, as well as the setup required, the general precautionary measures, position of the patient on the operating table, skin preparation, and draping procedure to be carried out.

Benign Esophageal Obstruction

Considerations.—Benign esophageal obstruction may be due to the swallowing of a *caustic* substance, to an infection, or to foreign bodies. When an ulcer forms in the *esophagus*, the muscular structure is replaced by dense connective tissue, thereby narrowing the esophageal lumen.[2,3,10]

Treatment.—When a caustic material has been swallowed, emergency measures are first carried out; then a gastrostomy may be done. Foreign bodies are

If a thoracicoabdominal approach is to be used, proper equipment is needed to remove accumulated air from the chest cavity and to establish a closed drainage system (Figs. 231 and 273) (Chapters 9 and 11). In most patients a Levin tube has been introduced previously for continuous gastric suctioning.[3, 6, 17, 18]

Transfusion and infusion sets, whole blood, 5 per cent dextrose in distilled sterile water, normal saline in distilled water, or other parenteral fluids should be ready since the patient's blood loss is replaced during the operation. Drainage tubes and catheters should be in perfect condition (Chapter 2). All sponges and pads should be accounted for before the anastomosis is completed and the abdominal wound is closed (Chapter 4).

When a 95 per cent solution of phenol is to be used to cauterize tissues, the circulating nurse pours a small amount into a sterile medication cup and places it in a small basin kept on the instrument table. The gowned and gloved nurse holds the basin a distance from the wound as the surgeon wets the scalpel with the phenol, and then hands him cotton swabs dipped in a solution of 70 per cent alcohol. These items are removed from the sterile field immediately after use. The circulating nurse disposes of the phenol solution, rinses the cup and scalpel thoroughly under running water, and places the instruments in the tray of the instrument-washer sterilizer. If the instruments are needed immediately, they are sterilized in the high-speed pressure sterilizer (Chapter 2).

If an electric cautery is to be used, it must be properly connected and tested before the patient arrives (Chapter 2). The anesthetist also must be told beforehand so that he will be able to carry out the necessary safety measures to prevent a possible explosion if an inflammable anesthetic is being used.

Hemostats and sutures of a sufficient length and size are needed to control bleeding (Chapters 4 and 5). Fine-pointed hemostats and fine sutures are needed to close the gastrointestinal layers.[3, 10, 12, 17, 19] In an anastomosis a long suture of fine chromic gut may be used to approximate the mucosal layers (Chapter 5).

To reduce trauma the jaws of heavy intestinal forceps may be protected by pieces of soft rubber tubing These pieces should fit the jaws firmly but not tightly The guards should not be sterilized since during the sterilization process the rubber will erode the metal and will prevent proper penetration of steam. When a Von Petz anastomosis clamp is to be used, the scrubbed nurse makes sure that it is properly filled and that the jaws are left open during sterilization. After completion of the operation, the clamp should be taken apart and sterilized in the pressure washer-instrument sterilizer (Chapter 2). It may be soaked in a detergent solution for 30 minutes, then rinsed, and sterilized in the high-speed sterilizer (Chapter 2). After completion of the sterilization process, the instrument should be reassembled, threaded, and stored.

To prevent contamination of the wound, the diseased portions of the intestine or stomach are walled off with moist gauze pads. A suitable suction tip is needed to carry off the materials in the opened bowel. When an open anastomosis is to be done, a moistened piece of narrow packing may be placed between the involved organs at a point beneath the site of the anastomosis and the proposed incisional sites surrounded by two moist pads. These pads may be covered with large pieces of cellophane. Before an aseptic anastomosis is

the isolation of the diverticulum. In the second stage, which is performed seven to twelve days later, the wound is reopened and the sac is dissected and ligated as described in the one-stage operation.

Partial Esophagectomy and Intrathoracic Esophagogastrostomy

Definition.—Through a posterolateral incision in the left chest, including a resection of the seventh, eighth, or ninth rib and a division of the two involved ribs, the diseased portions of the stomach and esophagus are removed, and an anastomosis is established.

Purpose.—To remove benign strictures of the lower esophagus which may develop following trauma, infection, corrosion, or chromic granulomas, or to remove tumors which are situated in the cardia of the stomach or in the lower three-fourths of the esophagus.[2, 3, 10, 20]

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, plus items listed previously for esophagectomy. The patient is placed on the operating table in a posterolateral position, and a posterolateral approach is used (Chapter 9). Before surgery a Levin tube is passed into the esophagus. Blood is generally administered by a canula which is inserted into the saphenous vein of the ankle (Chapter 4). A chest drainage set (Fig. 234) and cardiac arrest setup should be available (Chapter 10).

Operative Procedure.—

Steps	*Items*
1-6. The skin incision is carried downward midway between the vertebral border of the scapula and the spinous processes to the [illegible] that [illegible] ction [illegible] the vertical portion of the incision will depend upon the location of the tumor. The wound is retracted. Bleeding vessels are ligated. The chest cavity is opened.	1-6. As for lobectomy (Chapter 9)
7. The lung is retracted. The mediastinal pleura is incised in line with the esophagus and the lesion. The esophagus is dissected free from the aorta. The left bronchial arteries are cut and ligated.	7. Duval forceps, Deaver retractor, moist packs, scalpel, curved thoracic scissors, suction set, thoracic tissue forceps, long curved and angled hemostats, silk Nos. 3-0 and 2-0; and umbilical tape
8 The phrenic nerve is crushed; the diaphragm is opened. The stomach is mobilized by dissection of its ligamental attachments. The left gastric artery and branches of the hepatic artery are cut and ligated (Fig. 294).	8. Nerve hooks, angled, curved thoracic clamps, long curved Harrington scissors, silk No. 2-0

removed by means of an endoscope (Chapter 8). Structures may be dilated, using graduated bougies, which are passed through an esophagoscope. If repeated dilation is unsuccessful, the lesion is resected.

Excision of Esophageal Diverticulum

Definition.—Through an incision over the inner border of the sternocleidomastoid muscle, and extending from the level of the hyoid bone to a point 2 cm. above the clavicle, the sac of the diverticulum (pouch) is freed and ligated and the pharyngeal muscles and surrounding tissues closed.

Considerations.—Excision of esophageal diverticulum may be accomplished in a one-stage or two-stage operation [2,3,12]

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal operations. The patient is placed on the operating table in a slight reverse Trendelenburg position (Chapter 7). Routine skin preparation is carried out as for thyroidectomy (Chapter 7). The patient is draped with a fenestrated sheet (Figs 89 to 94).

Operative Procedure.—A description of the one-stage operation accompanies Fig. 302 The two-stage operation is similar to the one-stage up to and including

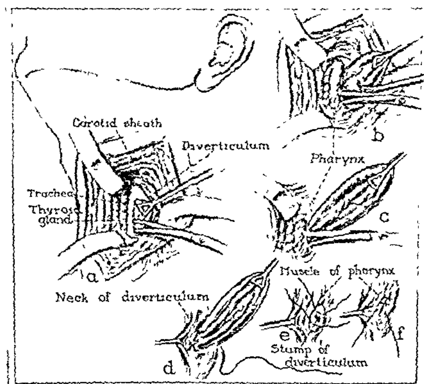


Fig. 302—Harrington technique for the one stage esophageal diverticulectomy is shown as follows: *a*, The wound is opened, the thyroid retracted medially, and the carotid sheath with the sternocleidomastoid retracted laterally, exposing the diverticulum. *b*, The diverticulum is dissected free from the surrounding structures down to the neck *c*, The true neck of the sac is dissected from the surrounding muscles of the posterior wall of the pharynx *d*, The neck of the sac is ligated with chromic gut sutures *e*, The stump of the sac is invaginated into the wall of the pharynx *f*, The opening in the pharyngeal muscles is closed (From Harrington, S W.: Surgery 18 76, 1945)

the cardia of the stomach or due to a stricture of the esophagus. A temporary gastrostomy is done when the obstruction is capable of being corrected. One of several methods may be used, such as Stamm, Janeway, or the Witzel operation. A permanent gastrostomy is done when an extensive lesion is present in the esophagus. In this operation a stomach flap is formed around the catheter.

Purpose.—To establish an opening from the skin into the stomach to permit liquid feeding, or retrograde dilatation of an esophageal stricture.

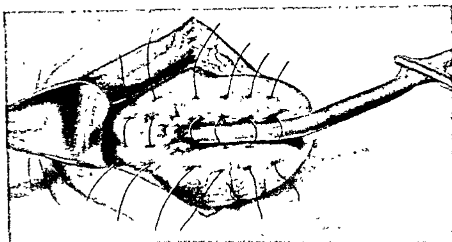


Fig. 303.—The Witzel gastrostomy. The tube has been fastened in the stomach and laid on the surface of the stomach. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, vol. I, St. Louis, 1953, The C. V. Mosby Co.)

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery and items listed for gastrostomy. The patient is placed on the operating table in a supine position (Chapter 4). Routine skin preparation is done (Chapter 3), and patient is draped with small sheets or fenestrated sheet (Chapter 4).

Operative Procedure.—

	Steps		*Items*
1-6	The abdominal cavity is opened; the wound edges are protected.	1-6	As for celiotomy (Chapter 11); small instruments, sponges, and needles needed for children
7.	The stomach is held and a purse-string suture is placed at the proposed site for the entrance of the catheter.	7.	Allis or Allis-Adair forceps, Babcock forceps, chromic gut No. 2-0 swaged-on intestinal needle, needle holder, tissue forceps without teeth, scissors, Halsted hemostat
8.	The portion of the stomach surrounding the purse-string suture is protected with moist pads. An incision is made within the purse-string; the contents are suctioned away, the catheter inserted and sutured to anterior wall of the stomach; the purse-string is tied.	8.	Moist pads, scalpel with blade No. 10 or 15, tissue forceps, Halsted hemostats, Babcock forceps, suction set, sponges on holders, catheter (desired size), Asepto syringe (if desired), several interrupted sutures, needle holder, scissors

(Continued on page 472.)

Steps	*Items*
9. The stomach is divided and closed with two rows of chromic gut sutures and a third row of silk for reinforcement.	9. Payr or Doyen clamps, or Von Petz clamp, moist packs, cellophane packs, cautery, basin for soiled instruments, suction set, long chromic gut No. 2-0 suture swaged-on ½-circle taper-point needle, silk No. 3-0 swaged-on ½-circle intestinal needles, 2 needle holders
10. The freed esophagus is divided above the stricture or tumor. (In some cases the esophagus is divided after placement of the sutures for the anastomosis.)	10. Payr, Allen, or right-angled intestinal clamps, small packs, scalpel, basin for soiled instruments
11. The open (septic) method of anastomosis is generally preferred. A circular opening is made in the stomach, and the severed end of the esophagus is sutured to the opening. The mucosal layers are approximated; then the muscular layers of the esophagus and stomach are closed by two rows of interrupted sutures. Sutures may be placed in the esophagus and stomach before the stomach is opened, and the aseptic method for the anastomosis is followed.	11. As described for procedures to be carried out in septic or aseptic anastomosis, silk No. 3-0, 2 needle holders, plastic tissue forceps, scissors, small moist sponges on holders
12. The stomach is anchored to the pleura. The edges of the diaphragm are sutured to the wall of the stomach.	12. Interrupted sutures of silk No. 3-0 or 2-0, long tissue forceps, long needle holders, scissors
13. The pleura is cleansed with normal saline solution, which is suctioned off. A catheter is inserted for closed drainage (Fig 234) The chest wall is closed. The patient may be placed in his bed in a slight Trendelenburg position. Oxygen is administered through a nasal catheter. The Levin tube is generally removed before the patient is taken to the recovery room.	13. As for segmental lobectomy and thoracoplasty (Chapter 9); supports for body

Gastrostomy

Definition.—Through a high left rectus abdominal incision a temporary or permanent channel is established from the skin to the gastric lumen.

Considerations.—A gastrostomy, as a palliative procedure, is carried out to prevent starvation which may be due to a lesion situated in the esophagus or in

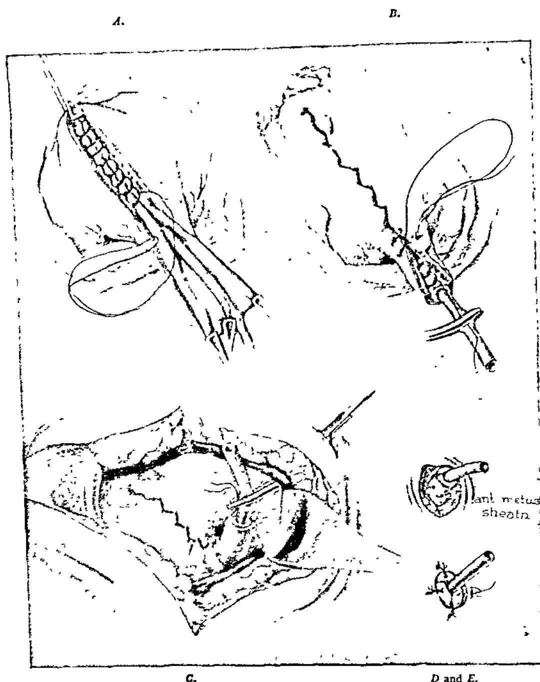


Fig 305.—*A*, The tube is fastened to the end of the flap with a clamp. The gastric mucosa is being sutured with a continuous lock stitch. *B*, The suture in the gastric mucosa has been completed and the end of the suture caught with a clamp on the end of the tube A layer of right-angle sutures buries the first row of sutures in the mucosa *C*, A Kelly forceps has been introduced through the short wound to the left of the incision, as described in the text. The catheter and the suture are caught in the forceps and drawn through the short wound onto the abdominal wall. *D*, The external portion of the constructed gastrostomy tube is sutured to the anterior sheath of the rectus muscle. *E*, The gastric mucosa is fastened to the skin with a few sutures (From Horsley, G. W, and Bigger, I A: Operative Surgery, vol. I, St. Louis, 1953, The C V. Mosby Co)

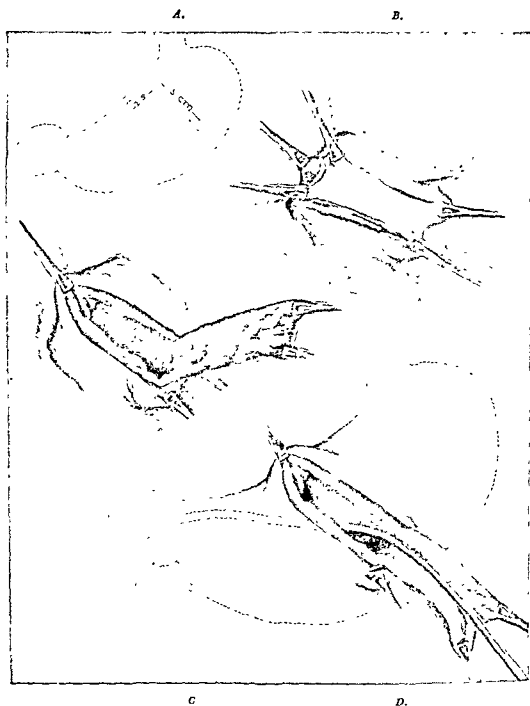


Fig 304 —*A*, Diagram of the stomach showing the outlines of the flap in the Janeway operation *B*, An incision has been made around the flap except at its base *C*, The flap is turned down and the gastric wound is converted into a triangle *D*, A rubber catheter is introduced through the pylorus and rests on the mucosa of the flap. (From Horsley, G W, and Bigger, I A.: Operative Surgery, vol. I, St Louis, 1953, The C V Mosby Co)

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including setup listed for gastrojejunostomy. The patient is placed on the operating table in a supine position, and routine skin preparation and draping procedure for a celiotomy are done (Figs. 12, 91, 263) (Chapters 3, 4, and 11).

Operative Procedure.—

Steps	*Items*
1. The abdominal wall and the peritoneal cavity are opened; the wound edges are protected and retracted; and the peritoneal cavity is explored.[2, 10, 11, 20]	1. As described for opening of celiotomy (Chapter 11)
2. The transverse colon is lifted upward and an opening made in the bloodless area of the mesocolon. Portion of the posterior wall of the stomach is drawn through the opening.	2. Moist packs, Allis-Babcock and Allis-Adair forceps, long curved scissors, tissue forceps, Crile hemostats, ligatures silk No. 3-0 or chromic gut No. 2-0
3. The transverse mesocolon is sutured to the upper portion of the posterior wall of the stomach to avoid a herniation of the small intestine into the peritoneal cavity.	3. Several interrupted fine chromic gut or silk sutures, swaged-on intestinal ½-circle needles, 2 needle holders, scissors, tissue forceps without teeth
4. The jejunum is grasped and freed from the mesentery and approximated to the stomach with the distal loop of the jejunum toward the greater curvature.	4. Allis-Adair or Allis-Lockwood forceps, Babcock forceps, moist packs placed between the approximated jejunum and stomach to prevent soiling, hemostat or silk suture attached to packing
5. Traction sutures are placed through the serosal layers at each end of the selected portion of the jejunum and stomach.	5. Rubber-shod clamps or gastroenterostomy clamps may be placed on stomach and jejunum; interrupted silk No. 2-0 sutures on ½-circle intestinal needles, gastroenterostomy clamps
6. The posterior serosal and muscular layers of the stomach and jejunum are united.	6. Continuous suture of chromic gut No. 3-0 or silk No. 3-0 or 4-0 swaged-on straight or ½-circle intestinal needle; free end of suture placed on sponge and fastened to towel with clamp
7. The operative field is draped for anastomosis.	7. Cellophane, pads, towels, suction set, basin for instruments, small metal tray on portable table with instruments for open anastomosis, as described for open anastomosis

Steps	*Items*
9. A stab wound may be made in the margin of the left rectus muscle near the costal margin. The clamped catheter is drawn through the wound.	9. Scalpel, hemostats, ligatures, curved Mayo-Pean or Crile hemostat, sutures
10. The stomach is sutured to the peritoneal layer; the abdominal wound is closed in layers.	10. As for closure of celiotomy (Chapter 11)

Gastrotomy

Definition.—Through a left paramedian abdominal incision the stomach wall is opened, its interior explored, and the foreign body removed.

Purpose.—To remove foreign bodies such as glass particles, nails, hair, or phytobezoar, particularly seeds and grape skins, or to explore the interior of the stomach.[3, 6]

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including setup listed for gastrotomy. The patient is placed on the operating table in a supine position (Chapter 4); routine skin preparation and draping procedure as described for celiotomy (Chapters 3, 4, and 11).

Operative Procedure.—

1. The abdominal wound is protected, and a longitudinal incision usually is made through the anterior wall of the stomach, halfway between the curvatures, where fewer arteries are encountered. The stomach wall is grasped and elevated by Allis-Adair or Babcock forceps. The bleeding vessels are ligated with fine-gauged silk or chromic gut ligatures.

2. The proposed site is walled off with moist packs, and an incision is made through the mucosa, a suction tube is introduced into the stomach to withdraw the gastric contents; then the foreign body or tumor is removed if present.

3 The layers of the stomach wall and the abdominal wound are closed

Gastrojejunostomy

Definition.—Through a right or left paramedian abdominal incision a permanent communication is made, either between the proximal jejunum and the anterior wall of the stomach or between the proximal jejunum and the posterior wall of the stomach, without removing a segment of the gastrointestinal tract.

Considerations.—Gastrojejunostomy is performed in treating a benign obstruction at the pyloric end of the stomach or an inoperable lesion of the pylorus and upper duodenum when a partial gastrectomy would not be feasible.[2, 3, 21, 22]

Purpose.—To introduce the duodenal contents with its alkaline constituents into the stomach, thus reducing the acidity of the gastric juices and providing physiologic rest to the stomach, also to provide a large opening without sphincteric obstruction.

Considerations.—A pyloroplasty may be done in treating a peptic ulcer under selected conditions or to remove cicatricial bands in the pyloric ring.

Purpose.—To relieve the spasm and permit rapid emptying of the stomach and to provide for regurgitation of alkaline duodenal juices with the acid secretions in the stomach.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including setup listed for pyloroplasty. Skin preparation is discussed in Chapter 3. The patient is placed on the operating room table in a supine position; an infant may be supported with a baby board (Chapter 4). Draping procedure for celiotomy is used (Chapter 4).

Operative Procedure (Horsley-Heineke-Mikulicz Technique).—The abdomen is opened as described for muscle-splitting incision (Chapter 11). An incision is made through the stomach and one third of the duodenum. The pyloric canal is divided, the diseased portion removed, and the contents of the bowel suctioned away. Continuity of the gastrointestinal tract is established with sutures.[17-19] The abdominal wound is closed as described for closure of celiotomy (Chapter 11).

Closure of Perforated Gastric or Duodenal Ulcer

Definition.—Through a high right rectus or midline abdominal incision the perforation in the stomach or duodenum is closed.

Considerations.—The patient with a perforated gastric or duodenal ulcer is treated as an "emergency" and the operation is performed promptly after the diagnosis has been made. A gastric lavage is not performed, but continuous suction is used.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery. The patient is placed on the operating table in a supine position (Chapter 4). Routine skin preparation and draping procedure for celiotomy are carried out (Chapters 3, 4, and 11).

Operative Procedure.—The abdomen is opened (Chapter 11), the involved portion of the stomach or duodenum examined, the exudate in the peritoneal cavity removed by suctioning, the perforation closed, and an omental "tag" sutured over the perforated site.[3, 11, 20]

Pyloromyotomy (Fredet-Rammstedt Technique)

Definition.—Through a high upper right rectus abdominal incision, about three inches long, the abdnominal cavity is opened and the thickened muscles of the pyloric ring are separated.

Considerations.—The cause of the hypertrophied pyloric sphincter is unknown. It usually occurs in infants, often in boys 4 to 6 weeks of age. At first the pyloric sphincter becomes hypertrophied, and as the muscular layers increase in size and become thickened, the mucosal layer becomes edematous, thereby impairing the pyloric opening.

An important clinical symptom is vomiting without bile, which eventually becomes continuous. Other symptoms include dehydration, weight loss, scanty

Steps	*Items*
8. The jejunum and stomach are opened. Bleeding vessels are ligated. Payr intestinal clamp may be placed across proposed lines of incision before the incisions are made. Inner posterior row of sutures is placed, and then first anterior row. Suture is doubly tied and cut.[7] (Figs. 312 and 313.)	8. Scalpel, suction set, Kelly or Halsted curved and straight hemostats, moist small sponges, fine tissue forceps, Judd-Allis or Allis forceps, continuous chromic gut No. 2-0 or 3-0 swaged-on ½-circle or straight intestinal needle, single or double-armed needle
9. The soiled pads, towels, and instruments are removed.	9. As described for gastrointestinal anastomosis
10. The original suture used posteriorly is continued as the anterior seromuscular layer. The traction sutures are removed The anastomosis is reinforced with interrupted sutures, silk No. 4-0. The marginal opening in the mesocolon is sutured to the stomach wall.	10. As described for gastrointestinal anastomosis
11. The omentocolic mass in the abdomen is replaced and the abdominal wound closed as for celiotomy.	11. As described for celiotomy (Chapter 11)

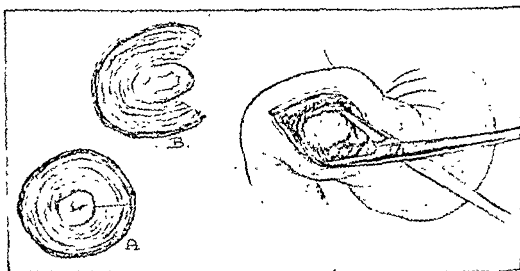


Fig 306 —Pyloroplasty An incision has been made and the submucosa of the pyloric canal is exposed *A*, Cross section of congenital pyloric stenosis before the incision *B*, Cross section after the incision (From Horsley, G W, and Bigger, I A Operative Surgery, vol. 1, St. Louis, 1953, The C. V. Mosby Co)

Pyloroplasty

Definition.—Formation of a larger passageway between the prepyloric region of the stomach and the first or second portions of the duodenum, and excision of the peptic ulcer, if present.

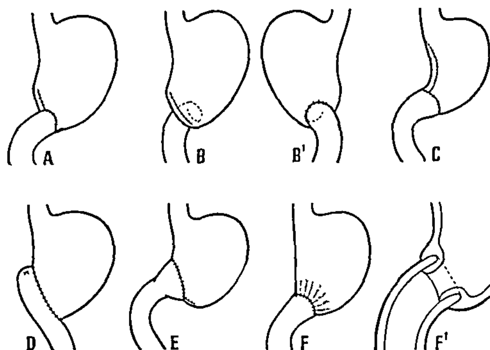


Fig 307.—Diagrams illustrating resections of the stomach with an anastomosis of the stomach and duodenum (gastroduodenal anastomosis). All of these types in which the stomach is brought to the duodenum are modifications of the Billroth I.

A, Billroth I After the pylorus has been removed, the lesser curvature is partially closed and the duodenum is sutured to the open end of the stomach at its lower margin

B, Kocher. In this case the distal end of the stomach is closed and the duodenum is brought up to the posterior margin of the closed stomach. *B'*, Posterior view showing the end of the duodenum anastomosed to the stomach.

C, Schoemaker In this instance the lesser curvature of the stomach is sutured and brought down to the same size as the duodenum and then an end-to end anastomosis is done

D, Von Haberer-Finney. In this operation the side of the duodenum is brought up to the end of the stomach so that the entire end of the stomach is open.

E, Horsley. The Horsley type of gastroduodenal anastomosis uses the lesser curvature end of the stomach to suture to the duodenum and closes the greater curvature end.

F, Von Haberer A modification of the operation shown in *D* The stomach is, so to speak, narrowed or puckered so that it fits the end of the duodenum A modification of this has been done by some in the following way. The duodenum is split longitudinally and its ends are flared open so that the opening will be large enough to fit the open end of the stomach *F'*, Another modification of von Haberer gastroduodenostomy. The stomach wall is folded over on the invaginated duodenum.

(From Berman, J K Principles and Practice of Surgery, St. Louis, 1950, The C V. Mosby Co)

stools, and alkalosis. If these symptoms are confirmed by palpation and examination under the fluoroscope, surgery is indicated.[11, 17-19]

Purpose.—To relieve a pyloric stenosis which is causing an obstruction at the exit of the stomach.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery. The infant's arms and legs may be wrapped with cotton and secured by means of bandages to a padded wooden bed board in such a way that the circulatory or respiratory functions are not restricted (Chapter 4). A mild antiseptic solution is used to clean the skin area (Chapter 3). The patient is draped with sterile regular sheets or a small fenestrated sheet (Chapter 4).

Operative Procedure.—The skin and sucutaneous tissues are incised, the rectus muscle is split and retracted and the border of the liver retracted.

The surgeon delivers the pylorus into the wound, holds it between his fingers, and makes an incision through the pyloric ring. The thickened cut muscle is spread apart, allowing the mucosal layer to bulge. The abdominal wound is closed in layers (Chapter 11).

Achlasia

Definition.—Elimination of the narrow segment and closure of the anterior wall of the esophagus.

Purpose.—To treat a failure of the stomach muscle fibers of the lower esophagus to relax.[3]

Setup and Procedure.—Similar to pyloromyotomy.

Partial Gastrectomy (Billroth I Technique)

Definition.—Through a median incision, a paramedian abdominal incision which extends from the ensiform cartilage to or below the level of the umbilicus, or a transverse abdominal incision, the diseased portion of the stomach is resected and an anastomosis is established between the stomach and duodenum.

Considerations.—The Billroth I operation may be selected because the normal duodenum has more resistance to hydrochloric acid than other portions of the intestinal tract, and the exit centers of peristalsis are situated along the lesser curvature of the stomach, whereas the greater curvature has no such function. The mechanical activity which occurs along the lesser curvature forces the food particles into the intestine as the pyloric sphincter relaxes. From the physiologic aspect, the Billroth I operation appears to be the operation of choice, although it may not always be performed because of mechanical problems. In recent years it is increasing in popularity.[2, 6, 10, 21-24]

One of several other techniques may be followed to establish gastrointestinal continuity. They include the Schoemaker, the Von Haberer-Finney, and other modifications of the Billroth I operation (Fig. 307).

Purposes.—Partial gastrectomy is performed to remove a benign or malignant lesion that involves the pyloric half of the stomach or a lesion that involves the upper portion of the duodenum (gastroduodenostomy).

Steps	*Items*
7. The sutures in the posterior serosal layers are tied and free ends cut, except those for traction. The involved segments may be clamped during anastomosis.	7. Scissors, tissue forceps without teeth, Doyen or Scudder intestinal rubber-shod clamps, Kelly and Crile hemostats
8. Anastomosis is completed and the excess in the stomach of the lesser curvature is closed. Abdominal wound is closed and dressed.	8. Sutures as described for posterior gastroenterostomy and for closure of celiotomy

Partial Gastrectomy (Billroth II Technique and Modifications)

Definition.—Through an abdominal incision the distal stomach is resected and anastomosis established between the stomach and the jejunum.

Considerations.—The Billroth II method and modifications may be selected since the acidity of the gastric juice will be reduced by removal of a large segment of the stomach, and the anastomosis can be made along the greater curvature or at any point along the stump of the stomach. Modifications of the Billroth II operation include the Polya and Hofmeister operations, and the continuity of the gastrointestinal tract is accomplished through by-passing the duodenum (Fig. 308). After surgery the duodenal and jejunal secretions empty into the remaining gastric pouch and aid in neutralizing the hydrochloric acid. The stomach empties more rapidly because of the larger opening, thus limiting the development of a high concentration of acid.[2, 6]

Purpose.—To remove a benign or malignant lesion in the stomach or duodenum.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for partial gastrectomy, Billroth I technique.

Operative Procedure.—The items used to perform the various steps are similar to those listed under Billroth I operation.

Steps	*Items*
1-4. The abdomen is opened; the stomach, duodenum, and omentum are freed. Arteries and veins are clamped, divided, and ligated.	1-4. As described for Billroth I method
5. A portion of the stomach is removed (Fig. 311).	5. Von Petz anastomosis clamp or Payr clamps, scalpel or cautery (Chapter 11)
6 The duodenum is divided and the duodenal stump closed, using aseptic (closed) technique; the open end of the stomach is closed in layers, using continuous and interrupted intestinal sutures.	6 Small Payr, Allen, or Ochsner clamps, scalpel or cautery, sutures as described for gastroenterostomy
7. A side-to-side anastomosis is effected between the stomach and the jejunum, as described for gastroenterostomy. The abdominal wound is closed and dressed.	7. Chromic gut No. 3-0, silk No. 3-0, 4-0, swaged-on intestinal needles, needle holders, sponges on holders, scissors, fine tissue forceps, Halsted and Babcock forceps

Setup, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including basic setup for gastric resection. The patient is placed on the operating table in a supine position (Chapter 4). Routine skin preparation (Chapter 3) and draping procedure for celiotomy (Chapter 4) are carried out. Aseptic techniques for open or closed anastomosis are followed as previously described in this chapter.

Operative Procedure (Billroth I Technique).—The items used to perform the operation (Fig. 307) are listed opposite the following steps:

Steps	*Items*
1. The abdominal wall is incised and the peritoneal cavity opened and explored. Bleeding vessels are ligated. The abdominal wound is retracted, and the surrounding organs walled off with moist laparotomy pads.	1. As described for opening celiotomy (Chapter 11); skin instruments discarded in basin, skin towels, towel forceps, and tissue forceps with teeth, laparotomy pads, retractors, scalpel, scissors, hemostats, and ligatures
2. The omentum on the greater curvature of the stomach is freed down to the duodenum (Fig. 309).	2. Scissors, hemostats, Allis forceps, chromic gut or silk sutures No. 2-0, moist laparotomy pads, sponges on holders, suctioning set
3. The gastrocolic omentum is freed from the colon mesentery to prevent injury to the middle colic artery (Fig. 295). The vessels in the gastrocolic omentum, right and left gastroepiploic arteries, and the veins are clamped, divided, and ligated, thereby freeing the greater curvature of the stomach. The gastrohepatic vessels are divided and ligated and the diseased portion of the stomach is then free (Fig. 309).	3. Deaver and self-retaining retractors, laparotomy pads, long Harrington or Metzenbaum scissors, long tissue forceps with and without teeth, curved Mayo-Pean, Allis and Crile forceps, free ligatures, suture ligatures, needle holder, scissors
4. The upper portion of the duodenum just distal to the pylorus and the pylorus are clamped and divided.	4. 2 Payr, Allen, or Ochsner clamps, 3 moist pads, scalpel or cautery knife, basin for soiled instruments, sponges on holders
5. The stomach is exposed by lifting up clamp which is attached to the duodenum. The stomach is divided between the clamps.	5 Payr clamps or Von Petz clamps, laparotomy pads, scalpel
6. The opened stomach is approximated to the duodenum by a series of interrupted sutures placed in the serosal layers of the stomach and duodenum. These sutures are held with hemostats and the clamps removed. Stumps of the stomach and duodenum are cleansed, bleeding is controlled.	6. Moist sponges on holders, silk No. 4-0 or 3-0, or cotton No. 4-0 swaged-on ½-circle intestinal or French needles, tissue forceps without teeth, Halsted or Kelly hemostats, Allis-Adair forceps, Babcock forceps, chromic gut or silk No. 3-0 for ligatures

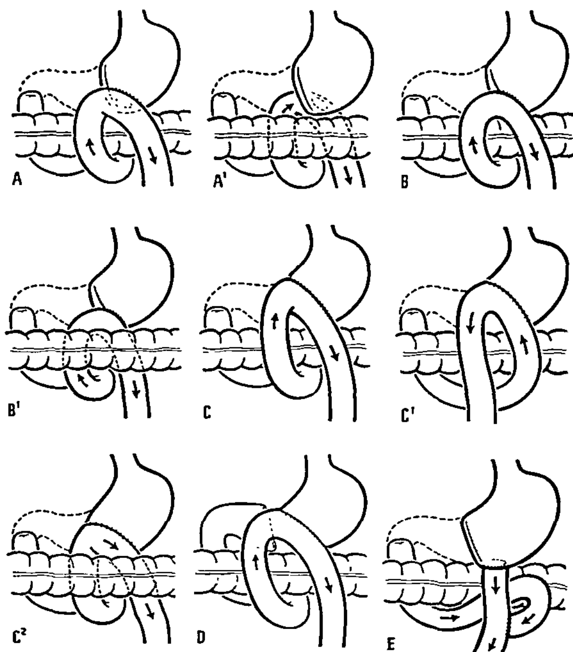


Fig 308 —*For legend, see opposite page.*

Fig 308 —Diagram illustrating resections of the stomach with an anastomosis to some part of the jejunum, in other words, gastrojejunal anastomoses All types of gastrojejunal anastomoses are modifications of the Billroth II. The modifications of this are as follows: (1) The end of the stomach is closed entirely as in the Billroth II and in the Mikulicz (2) The end of the stomach is partially closed (3) The end of the stomach is left entirely open and anastomosed to the side of the jejunum (4) The entire end of the stomach is anastomosed; however, the stomach is not resected but simply transected.

(1) *The end of the stomach closed.* *A*, Billroth II is a resection with side-to-side gastrojejunostomy anterior to the transverse colon and the anastomosis is isoperistaltic; that is, the current is from right to left or from lesser to greater curvature. It is an antecolic side-to-side gastrojejunostomy with isoperistaltic alignment. *A'*, The Mikulicz type is a retrocolic side-to-side gastrojejunostomy with isoperistaltic alignment of the jejunum.

(2) *The end of the stomach partially closed* *B*, Von Eiselsberg. The anastomosis is antecolic end-to-side isoperistaltic, but the superior portion of the stomach is closed for a greater part of its surface, thereby creating a small stoma This allows resection of a greater portion of the lesser curvature and decreases the size of the stoma, thereby tending to avoid the so-called dumping syndrome *B'*, Hoffmeister-Finsterer. This is a *retrocolic*, end-to side gastrojejunostomy and is isoperistaltic, that is, from lesser to greater curvature just as the von Eiselsberg type

(3) *The end of stomach entirely open.* *C*, Kronlein-Balfour. This is isoperistaltic, antecolic, and end-to-side The entire end of the stomach is anastomosed to the side of the jejunum *C'*, Moynihan *II*. This is an antiperistaltic, antecolic end-to-end gastrojejunostomy, *in other* words, the jejunum is brought up anterior to the transverse colon, the entire end of the stomach is sutured to the side of the jejunum, but the flow of the current is from greater to lesser curvature, thereby creating an antiperistaltic effect. *C'*, Reichel-Polya. This is an isoperistaltic (that is, from lesser to greater curvature), retrocolic, end-to-side gastrojejunostomy. This is one of the most common varieties employed today following a subtotal gastrectomy.

(4) *The stomach not resected.* These operations are known as the exclusion operations *D*, The stomach is divided, the distal portion is turned in, the proximal portion is brought up to the jejunum, usually according to the Reichel-Polya or Kronlein-Balfour type of end-to-side anastomosis. However, any of the varieties of anastomosis of gastrojejunostomy may be practiced The exclusion operation is rarely done except in those cases where the inflammatory process is too acute and the patient too sick to permit any further type of surgery. Later the antrum may be resected A modification of this is the one advocated by Finsterer in which, in addition to excluding the antrum, he takes out the mucous membrane of the antral portion which is supposed to secrete the acid-producing hormone. These have been known as the Divine exclusion and the Finsterer antral exclusion with and without resection of the antral mucosa *E*, The Roux type This is also known as the "En-y" type of anastomosis Here the jejunum is severed, the distal limb is sutured to the cut end of the stoma of the stomach or to the side of the stomach as in Billroth II, and the proximal limb is sutured to the side of the distal jejunum This operation is useful where there is an insufficient amount of bowel to bring up to the stomach or where this is technically not possible because of dense adhesions. This type of anastomosis avoids vicious circles and dumping syndromes which have been described in connection with other types of operations

(From Berman, J K Principles and Practice of Surgery, St. Louis, 1950, The C. V. Mosby Co)

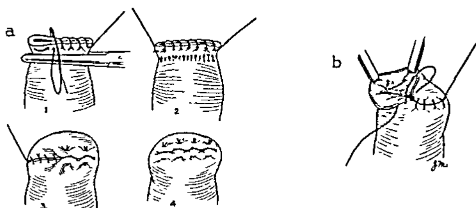


Fig 310—Partial gastrectomy for peptic ulcer—cont'd. Closure of distal end of divided duodenum can be made with clamp on duodenum *(a)* or with open duodenal segment. *b*, If duodenal cuff remaining above ampulla of Vater is short, or if ulcer is densely adherent, duodenum is transected without clamp and inverted with Connell sutures of chromic catgut as first suture layer (b) (Courtesy Lahey Clinic, Boston; from Marshall, S F.: S. Clin. North America 6:665, 1955)

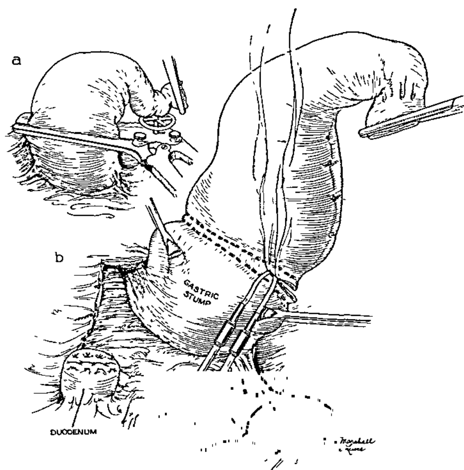


Fig 311.—Partial gastrectomy for peptic ulcer—cont d. Application of the Von Petz clamp Note inverted duodenal stump. The stomach is divided with cautery between double row of inserted metal clips (Courtesy Lahey Clinic, Boston; from Marshall, S. F.: S. Clin. North America 6:665, 1955)

Subtotal Gastrectomy (Posterior Polya Modification of the Billroth II Technique)

Definition.—Resection of the stomach and completion of a gastrojejunostomy.

Considerations.—Peptic ulcers usually occur in the duodenum, but they may also develop in the lower end of the esophagus or in the ileum (Meckel's diverticulum). Gastric ulcers may be either benign or malignant. The patients who are treated with subtotal gastrectomy may be classified as follows: Group I includes those patients who have a pyloric obstruction caused by recurring duodenal ulcers. As the ulcer heals it leaves a fibrosis at the exit of the stomach Due to the obstruction, the size of the stomach is enlarged so that its capacity is increased. Group II includes those patients with repeated or continuing bleeding due to ulcers. Group III includes those patients with chronic recurring ulcers which generally are situated in the posterior wall of the duodenum, with penetrating ulceration into the pancreas.

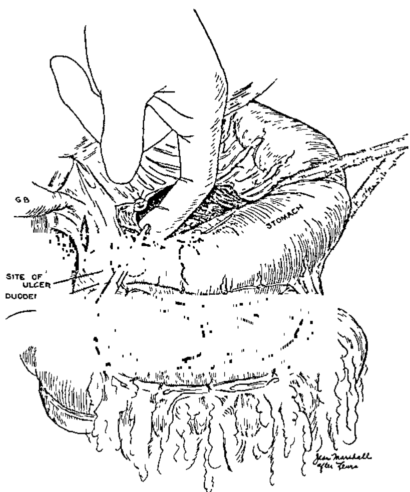


Fig 309.—Partial gastrectomy for peptic ulcer Mobilization of stomach Elevation of stomach by traction tape. Omentum has been removed in this instance but frequently is excised with stomach. Right gastroepiploic vessels have been ligated, right gastric artery is isolated and clamped Incision into the hepatoduodenal ligament is made to expose the common bile duct. (Courtesy Lahey Clinic, Boston, from Marshall, S F: S Clin North America 6:665, 1955)

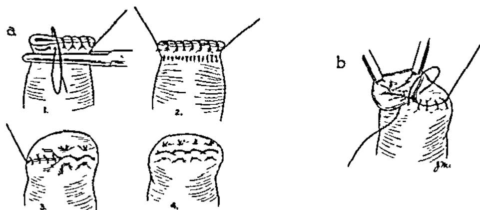


Fig 310 —Partial gastrectomy for peptic ulcer—cont'd. Closure of distal end of divided duodenum can be made with clamp on duodenum *(a)* or with open duodenal segment. *b,* If duodenal cuff remaining above ampulla of Vater is short, or if ulcer is densely adherent, duodenum is transected without clamp and inverted with Connell sutures of chromic catgut as first suture layer (b). (Courtesy Lahey Clinic, Boston; from Marshall, S F.: S. Clin North America 6:665, 1955)

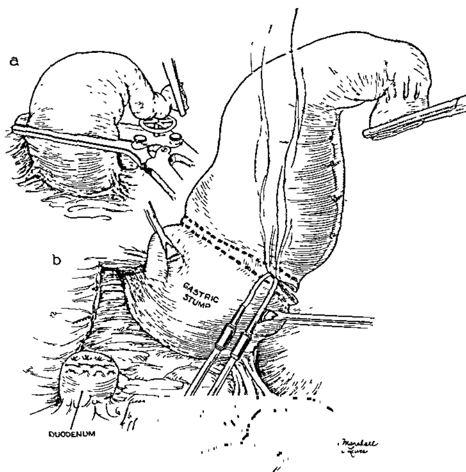


Fig 311 —Partial gastrectomy for peptic ulcer—cont'd Application of the Von Petz clamp Note inverted duodenal stump The stomach is divided with cautery between double row of inserted metal clips (Courtesy Lahey Clinic, Boston; from Marshall, S F.: S. Clin. North America 6:665, 1955)

Gastric cancer, involving the prepyloric segment of the stomach, is usually treated by high subtotal gastrectomy.

Purposes.—A subtotal gastrectomy is done to remove duodenal or gastric ulcers that have failed to respond to medical regime or to remove a gastric tumor.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including setup listed for subtotal gastrectomy. The patient is placed on the table in supine position, and prepared as described for a celiotomy (Chapters 4 and 11).

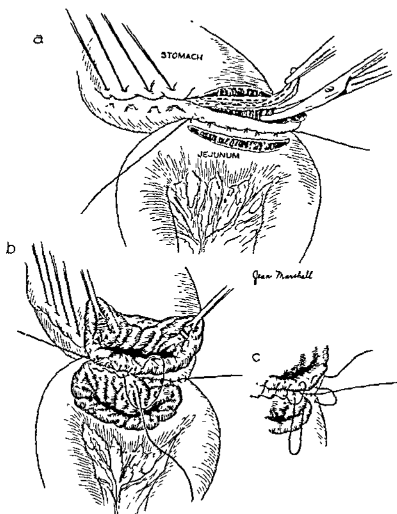


Fig 312—Partial gastrectomy for peptic ulcer—cont'd. *a*, The upper portion of the transected end of the stomach has been inverted with a running suture of chromic catgut and a second layer of interrupted sutures The gastrojejunal anastomosis is placed at the greater curvature end of the divided stomach Note excision of clips to open into the gastric lumen. Two-layer closure is used; *b*, first a mucosal layer of continuous catgut suture, and *c*, an outer serosal layer of interrupted silk sutures (Courtesy Lahey Clinic, Boston; from Marshall, S. F: S Clin North America 6:665, 1955)

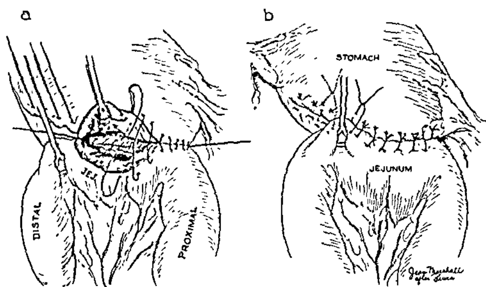


Fig. 313.—Partial gastrectomy for peptic ulcer—cont'd. *a*, Completion of gastrojejunal anastomosis. A continuous catgut suture inverts gastric and jejunal mucosa; outer reinforcing serosal and muscular sutures of interrupted silk. *b*, Distal jejunal loop is sutured to inverted end of stomach, thereby avoiding tension at angle of gastrojejunal anastomosis. Gastrocolic omental tag is tied at corner of anastomosis at greater curvature. Gastrohepatic omentum is used to reinforce corner at lesser curvature. (Courtesy Lahey Clinic, Boston; from Marshall, S. F: S. Clin. North America 6:665, 1955).

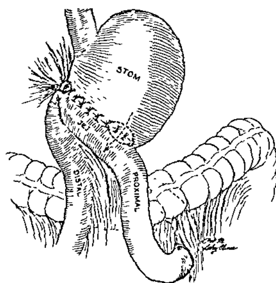


Fig. 314.—Completed gastric resection Note anastomosis anterior colon and position of jejunal segments to form the gastrojejunal anastomosis. (Courtesy Lahey Clinic, Boston; from Marshall, S. F.: S. Clin. North America 6:665, 1955)

Operative Procedure.—The items used and the aseptic techniques followed have been described previously in this chapter. In a subtotal gastrectomy the following steps are carried out:

Steps	*Items*
1-5. The abdominal cavity is opened and the involved portions of the stomach and duodenum are freed. The posterior surface of the stomach is explored through an opening made in the gastrohepatic omentum. (Fig. 309.)	1-5. As described for partial gastrectomy, Billroth I technique
6. The stomach is freed along the greater and lesser curvatures, and the blood vessels clamped, divided, and ligated. If extensive resection is necessary, the spleen may be removed, and in cases of carcinoma the gastrocolic and gastrohepatic ligaments are removed.	6. Silk No. 3-0, chromic gut No 0 or 2-0, tissue forceps, Mayo-Pean hemostats, long scissors, aneurysm needle, suture-ligatures threaded on Ferguson or Murphy needles, needle holder, scissors, Crile hemostats
7. The duodenum is freed from the pancreas; the right gastric artery and branches are clamped, divided, and ligated. The duodenum is divided near the pyloric ring (Figs 309, 310.) The duodenal stump is closed, using aseptic or septic technique.	7. Long dissecting scissors and hemostats, chromic gut No. 1 or silk No. 2-0, for blood vessels, Payr, Allen, or Ochsner clamps for duodenum, laparotomy pads, suction set, 2 continuous sutures, chromic gut No. 2-0 or 3-0, swaged-on intestinal needle for inner layers and interrupted sutures silk No. 3-0 or 4-0 for outer row of sutures

8. The pyloric end of the stomach, with clamp attached, is elevated. The left gastric artery along the lesser curvature is clamped, divided, and ligated.

9 The stomach clamp is placed on the stomach, which is then resected (Fig. 311) The left gastric artery may be doubly ligated and the stomach divided; then it is reflected to the right before the duodenum is divided.	9. Von Petz clamp, or 2 Payr clamps, moist laparotomy pads, scalpel or cautery, chromic gut No. 0 or silk No. 3-0, Mayo-Pean hemostats, curved scissors, scalpel
10. An opening may be made in the posterior mesocolon and the jejunal loop brought through it so that a posterior Polya operation can be carried out, thus joining the jejunal loop to the end of the stomach. The gastric jejunal anastomosis placed at the greater curvature end of the stomach is shown in Figs. 308 and 312	10. Long scissors, Allis-Adair forceps, Babcock forceps, items as described for gastrojejunostomy, using septic technique for anastomosis; fine dissecting instruments and sutures, suction cannula, and small sponges

Steps	*Items*
11. The opening in the mesocolon is sutured to the stomach. The abdominal wound is closed and dressed (Chapter 11).	11. Silk or cotton No. 3-0 or 4-0, or chromic gut No. 3-0 swaged-on ½-circle intestinal needle, needle holder, tissue forceps, scissors; all pads and instruments accounted for; items as for closure of a celiotomy (Chapter 11)

Total Gastrectomy

Definition.—Complete removal of the stomach, establishment of an anastomosis between a loop of the jejunum and the remaining portion of the esophagus, and an enteroenterostomy, if desired.

Considerations.—Total gastrectomy is done to help the patient to live for several years with less discomfort. The treatment of gastric tumors is surgery. The patient who has asymptomatic cancer, but refuses surgery, may live for a year or more before the tumor causes him great discomfort. If the patient has had symptoms for more than a few months, his chances for a complete recovery diminish rapidly. X-ray examination of the gastrointestinal tract is one of the most important diagnostic procedures [2, 9, 10, 14, 22]

Purposes.—The remove a malignant lesion of the stomach and metastases in the adjacent lymph nodes.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including setup previously listed for total gastrectomy. Safety measures are carried out to prevent the spread of cancer cells and contamination of the peritoneal cavity.

Operative Procedure (Lahey Technique).—The items are listed opposite the various operative steps.

Steps	*Items*
1-6 The abdomen is opened and retracted, and the peritoneal cavity protected	1-6. As described for opening of a celiotomy (Chapter 11)
7. The left lobe of the liver is detached from the diaphragm and retracted.	7. Moist pads, deep, wide retractors, Metzenbaum or Harrington scissors, suction set, sponges on holders, long Mayo-Pean hemostats
8 The stomach is freed; the duodenum is mobilized and divided and the distal end of the duodenum closed. The stomach is wrapped in a moist pad and covered with a piece of rubber dam or cellophane secured to the pad. The stomach is turned upward and used as traction until the esophagus is mobilized.	8. As for Polya technique for partial gastrectomy; moist pad, cellophane, Allis or Lahey forceps

Steps	*Items*
9. The lower end of the esophagus with the stomach is mobilized and the esophagus drawn down. The jejunum is brought up over the transverse colon and attached to the posterior wall of the lower end of the esophagus.	9. Interrupted silk sutures No. 3-0 and 2-0, as described for gastrointestinal surgery
10. The stomach is removed and an anastomosis completed. The peritoneal flaps are sutured to the jejunum, which is attached to the diaphragm. An enteroenterostomy may be performed (Fig. 315). Abdominal wound is closed.	10. As described for posterior gastrojejunostomy; interrupted silk sutures No. 3-0, catheter and sutures as described for enterostomy, and items for closure of celiotomy (Chapter 11)

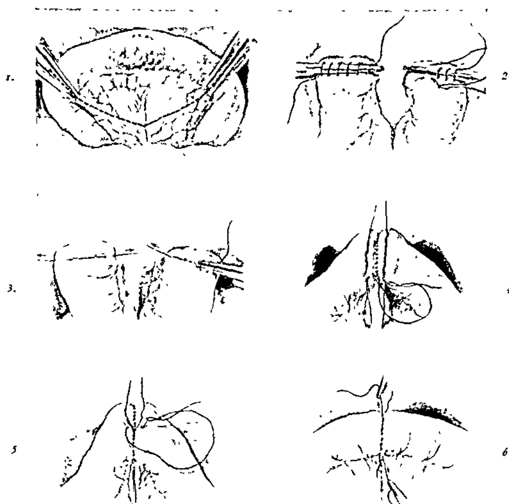


Fig. 315—End-to-end enteroenterostomy (closed method of Parker-Kerr). *1,* The site of lesion and placing of two sets of clamps Dotted lines indicate area for excision. *2,* Method of placing continuous inverting suture over clamps Ends of sutures left long *3,* Completing inverting sutures by drawing them taut as opened clamp is gradually withdrawn. *4,* Inversion completed. Continuous serosal suture placed and the musculoserous stitch begun. *5,* Posterior musculoserous suture placed. The suture now continued to approximate anterior surface. Serous suture completed. Mesentery approximated Original inverting sutures are now withdrawn (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J.)

Vagectomy

Definition.—Segmental resection of the vagus nerves as they lie on the lower esophagus. It may be done at a level either above or below the diaphragm.

Considerations.—Normally, the action of the digestive chemical processes and the mucous coating dilates and neutralizes the gastric juices, thereby protecting the gastrointestinal tract from corrosive irritation. When excessive amounts of gastric secretions form in the empty stomach, ulcers may develop.[1, 9] This condition is influenced by the actions of the vagus nerves (Chapter 6). When the fibers of the autonomic nervous system are overstimulated, the stomach contracts, the pyloric sphincter relaxes, and the amount of gastric secretion increases (Fig. 150). Some patients who have had a vagectomy complain of a fullness of the stomach, which becomes atonic and empties poorly, so that food fermentation follows, accompanied by foul eructations.[3, 6, 9, 25]

Purposes.—Vagectomy, which is usually combined with a partial gastrectomy, is done to reduce the incidence of marginal ulcer, to eliminate some of the undesirable effects of vagectomy alone, and to reduce or eliminate the cephalic phase of gastric secretions.

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including set listed for vagectomy. For thoracicoabdominal approach, the patient is placed on the operating table in a posterolateral position (Chapters 4 and 11).

Operative Procedure.—The peritoneal cavity is opened, and the wound edges are protected with towels and moist pads. The abdominal contents are walled off; the left lobe of the liver is retracted and the peritoneal membrane to the esophagus divided. The esophagus is mobilized and retracted, using tape. The vagus nerves are clamped, resected, and ligated or clipped with silver clips. The wound is closed without drainage and dressed.

Resection of Small Intestine

Definition.—Through an abdominal incision, which is made over the suspected site of the lesion, generally in the right lower quadrant, the diseased intestine is excised, and a suitable anastomosis is completed.

Purposes.—To remove certain tumors, a gangrenous portion of the intestine due to strangulation from bands of adhesions or a herniation of the intestine, or a volvulus.[7,11,21,26]

Setup, Precautions, Position, Skin Prepartion, and Draping Procedure.—As described for gastrointestinal surgery, including setup listed for intestinal resection. The patient is placed on the operating table in a supine position and prepared as described for celiotomy (Chapter 11).

Operative Procedure.—

1. The abdominal wall is incised and retracted; the peritoneal cavity is explored and protected with packs.
2. The clamps are placed above and below the diseased segment of the bowel and mesentery. The involved area is removed with a cautery or scalpel (Fig. 315).

3. The continuity of the gastrointestinal tract is established by one of the following: (a) An end-to-end anastomosis with the aseptic (closed) technique, using Rankin or Furniss clamp and needles, or the septic (open) technique may be followed. (b) A lateral (side-by-side) anastomosis with septic technique may be preferred.

Meckel's Diverticulum

Definition.—Removal of the diverticulum and establishment of bowel continuity.

Considerations.—An unobliterated congenital duct may remain attached to the terminal ileum. This embryonic yolk stalk may persist as an appendix-like structure arising from the lower ileum so that it causes an obstruction, local peritonitis, or hemorrhage. The diverticulum may contain gastric mucosa, which may ulcerate, perforate, or bleed.[11,17,20,21]

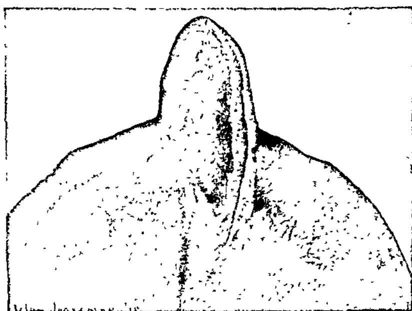


Fig 316—Meckel's diverticulum in the lower ileum (From Horsley, G. W, and Bigger, I. A.: Operative Surgery, vol I, St Louis, 1953, The C V. Mosby Co)

Setup, Precautions, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery, including setup listed for celiotomy, plus intestinal instruments.

Operative Procedure.—The abdomen is opened and the peritoneal cavity explored The procedure will depend upon the size of the diverticulum. If it is long with a narrow base, the steps of the operation are similar to those for an appendectomy (Chapter 13)

When the neck of the diverticulum is broad, the loop of bowel containing the diverticulum is isolated from the mesentery, and the base of the diverticulum is doubly clamped and divided, using Allen or Ochsner clamps and scalpel[2,3] An anastomosis of the divided ends is completed as described for posterojejunostomy. The wound is closed and dressed as described for closure of celiotomy (Chapter 11).

REFERENCES

1. Best, C. H., and Taylor, N. B: The Human Body. Its Anatomy and Physiology, ed. 3, New York, 1956, Henry Holt & Co, Inc.
2. Moseley, H F.: Textbook of Surgery, ed. 2, St Louis, 1955, The C. V. Mosby Co.
3. Shackelford, R T, and Dugan, H J.: Bickham-Callandar: Surgery of the Alimentary Tract, Philadelphia, 1955, W. B Saunders Co, vol. 1, chaps. 1, 2; vol. II, chaps 7, 8; vol. III, chap. 13.
4. Zoethout, W. D, and Tuttle, W. W.: Textbook of Physiology, St. Louis, 1955, The C. V. Mosby Co
5. Francis, C C: Introduction to Human Anatomy, St. Louis, 1949, The C. V. Mosby Co.
6. Berman, J. K.: Principles and Practice of Surgery, St Louis, 1950, The C. V. Mosby Co
7. Manual of Operative Procedure, Somerville, N. J., 1953, Ethicon Laboratories, Inc.
8. Anthony, C P.: Textbook of Anatomy and Physiology St. Louis, 1955, The C. V. Mosby Co.
9. Best, C H, and Taylor, N. B: Physiological Basis of Medical Practice, Baltimore, 1953, Williams & Wilkins Co
10. Christopher, F, and Davis, L.: Textbook of Surgery, ed. 6, Philadelphia, 1955, W. B. Saunders Co, chaps. 2, 3, 4, 8, 18, 20.
11. Mayo, C W.: Surgery of the Small and Large Intestine, Chicago, 1955, Year Book Publishers, Inc
12. Partipilo, A. V.: Surgical Technique and Principles of Operative Surgery, Philadelphia, 1949, Lea & Febiger, Inc.
13. Albert, H. L Partial Gastrectomy for Peptic Ulcer, Ann. Surg, 131:330, 1950.
14. Marshall, Samuel Total Gastrectomy, S Clin. North America 6:673, 1956
15. Bird, Brian Psychological Aspects of Pre- and Post-Operative Care, Am J. Nursing 55:685, Feb, 1955.
16. Positioning the Patient for Surgery, 1957, A.N.A-N.L.N Film Library, New York. Surgical Film Library, American Cyanamid Co, Danbury, Conn.
17. Gross, R E.: The Surgery of Infancy and Childhood. Its Principles and Techniques, Philadelphia, 1953, W. B Saunders Co, chaps. 6, 7, 9, 10, 11, 12.
18. Jeans, P. C, Wright, F. H., and Blake, F. G: Essentials of Pediatrics, ed. 7, Philadelphia, 1955, J B Lippincott Co, chap. 8
19. Ladd, W E, and Gross, R E: Abdominal Surgery of Infancy and Childhood, Philadelphia, 1948, W. B Saunders Co.
20. Maingot, R.: Abdominal Operations, ed 2, New York, 1950, Appleton-Century-Crofts, Inc.
21. Welch, C E: Surgery of the Stomach and Duodenum, Chicago, 1955, Year Book Publishers, Inc.
22. Wilder, J R: Atlas of General Surgery, St Louis, 1955, The C. V. Mosby Co
23. Marshall, Samuel Partial Gastrectomy for Peptic Ulcer, S Clin, North America, 6.661, 1956.
24. Wangensteen, O: Segmental Gastric Resection for Peptic Ulcer, J.A M.A 149:18, 1952.
25. Walters, W, and others: Vagotomy in the Treatment of Gastrojejunal Ulceration, J.A.M.A. 148:803, 1952.
26. Wangensteen, O H: Intestinal Obstruction, ed 3, Springfield, Ill, 1955, Charles C Thomas, Publisher.

CHAPTER 13

OPERATIONS ON GALL BLADDER, DUCTS, LIVER, PANCREAS, AND SPLEEN

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

The liver is situated in the upper right abdominal cavity, beneath the dome of the diaphragm, covered by the lower right ribs and lying above the stomach and duodenum (Fig. 317). The liver is covered with peritoneum except at its posterior surface which is attached to the diaphragm. Beneath the peritoneal covering is a dense connective tissue, called the "capsule of Glisson."[1-6]

The blood from the gastrointestinal tract (the stomach and small and large intestines) and from the spleen and pancreas is carried through the liver by means of the portal veins and their radicals (Chapter 12). The blood leaves the liver through the hepatic venous system to pass into the right side of the heart. The liver also receives arterial blood through the hepatic artery.

Bile is manufactured by the liver cells and is secreted into the fine biliary radicals, and, in turn, flows into the large ducts.[1,2] This ultimately leaves the liver through the right and left hepatic ducts. These ducts join together to form the common bile duct, which enters the second portion of the duodenum (Fig. 318). The cystic duct enters the common bile duct close to its beginning, thereby allowing bile to enter the common duct from the gall bladder.

The gall bladder, lying in a sulcus on the underside surface of the liver, is partially covered with peritoneum. The tapering neck of the gall bladder terminates in the cystic duct. When food (especially fats) is ingested, the musculature of the gall bladder contracts, pouring forth concentrated bile to assure digestion.[1,5,7,8] The gall bladder receives its blood supply from the cystic artery, a branch of the hepatic artery.[9,10]

The pancreas lies behind the stomach. Its relations to the duodenum are shown in Fig. 319. The spleen is located on the left side beneath the ninth, tenth, and eleventh ribs. Its peritoneal relations are shown in Fig. 320.

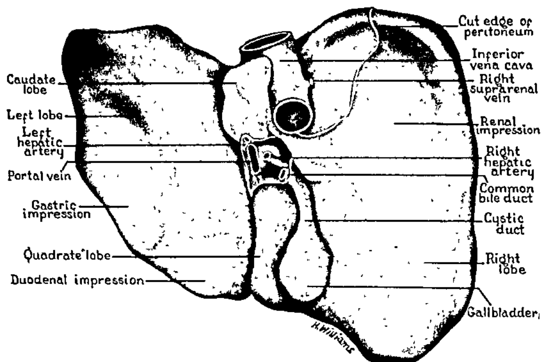


Fig 317.—Undersurface of the liver (From Francis, C. C, Knowlton, G. C., and Tuttle, W. W: Textbook of Anatomy and Physiology, St. Louis, 1943, The C. V. Mosby Co)

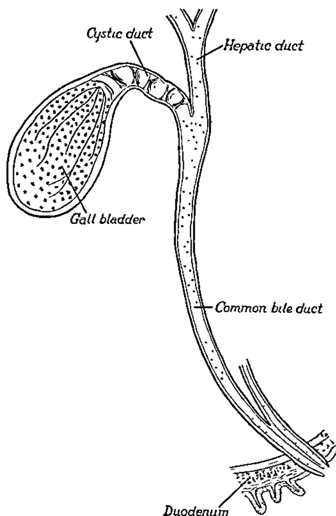


Fig. 318.—Diagram to show the Y formation of the three bile ducts. (From Anthony, C P.: Textbook of Anatomy and Physiology, St. Louis, 1955, The C. V. Mosby Co)

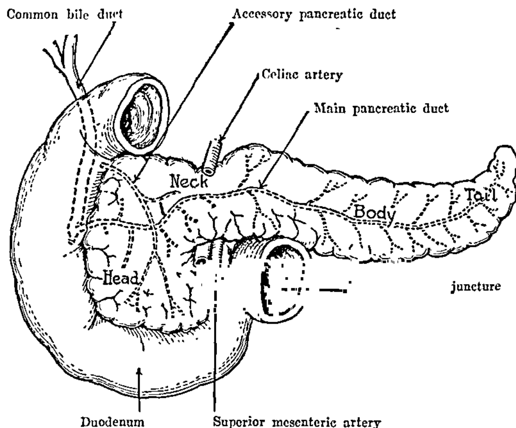


Fig 319 —Pancreas and duodenum. (From Pitzman, M: The Fundamentals of Human Anatomy, St. Louis, The C. V. Mosby Co)

BASIC SETUP FOR OPERATIONS FOR BILIARY SURGERY

The basic setup consists of the celiotomy setup (Chapter 11), plus the following:

1 Kelly retractor blade 3½ inches deep by 3 inches, length 9½ inches; or Doyen, 2 by 2½ inches, length 9¾ inches
1 Foss, Murphy, Meyerding, or Deaver blade 1¾ inches wide, length 9½ inches (Fig. 321)
2 Deaver retractors with handles, blades 1 and 1½ inches, length 12 inches
2 Lower, Shallcross or Rochester forceps, 7 inches (Fig 326)
2 Gray cystic duct forceps, 8 inches
2 Johns Hopkins, Moynihan, or Mixter gall duct forceps
2 Gilbert cystic duct forceps, straight
2 Ochsner gall bladder trocars, Nos 14 and 20 (Fig. 322)
1 Pool suction tip, angular, and rubber tubing or Strauss aspirating tube
1 Scalpel handle No 7, blade No. 10, or Mayo ureter knife
2 Judd-Allis, 3 and 4 teeth, 7¼ inches, or Allis forceps 5 and 6 teeth, 7½ inches
1 Judd-DeMartel or Lovelace gall bladder traction forceps (optional)
4 Mayo-Pean hemostats, curved, 8 inches
2 Ochsner hemostats, curved, 7¼ inches
1 Moore gallstone scoop, 12 inches
2 Mayo-Robson gallstone scoops (Fig. 322)
3 Ferguson or Despardin gallstone scoops, different sizes (Fig. 322)
2 Mayo-Blake gallstone forceps, curved and straight (Fig. 325)
1 Asepto syringe, 2 ounces

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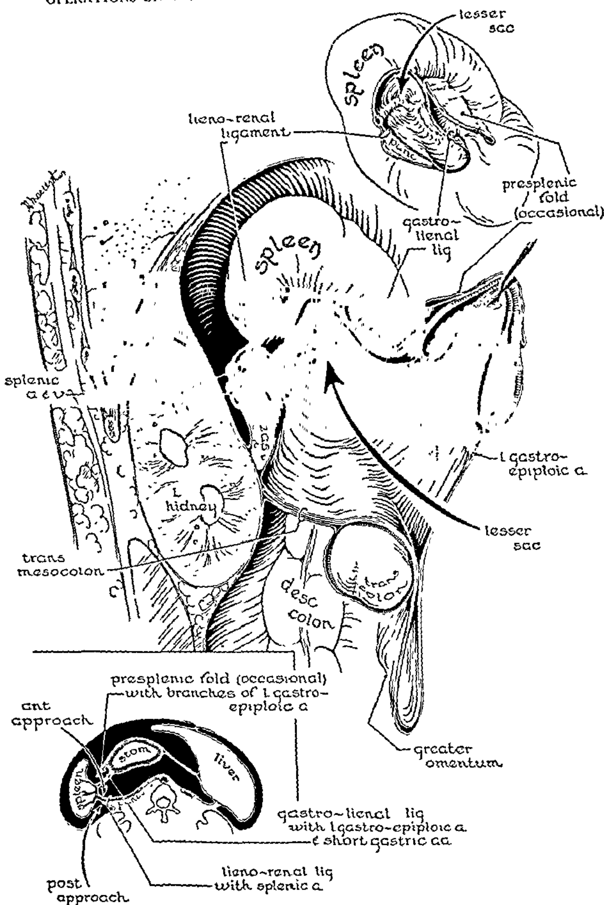


Fig 320.—Peritoneal relations of the spleen. (From Moseley, F. H.: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co.)

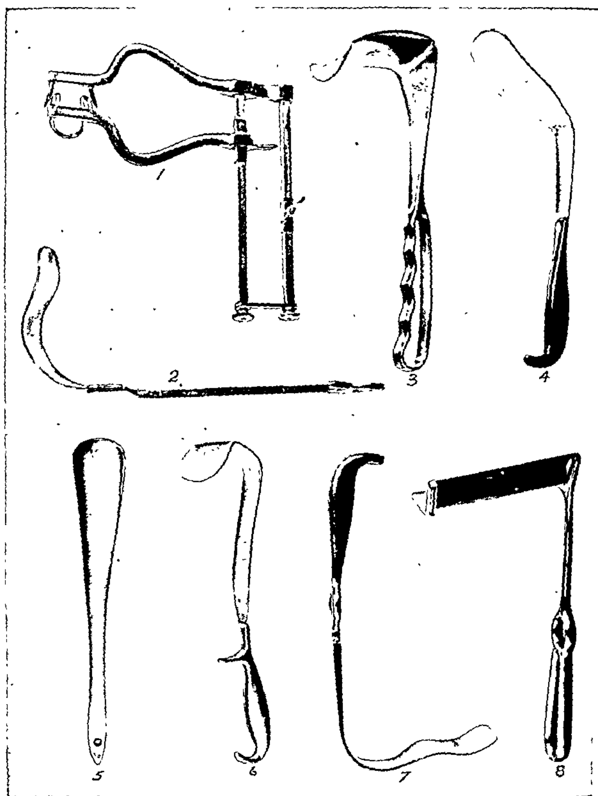


Fig 321.—Instruments for biliary surgery 1, Balfour self retaining retractor; 2, Hogan blade to fit the Balfour retractor, 3, Richardson deep retractor, 4, Murphy retractor; 5, Reverdin abdominal spatula; 6, Doyen retractor, 7, Grant retractor, 8, Wolfson retractor.

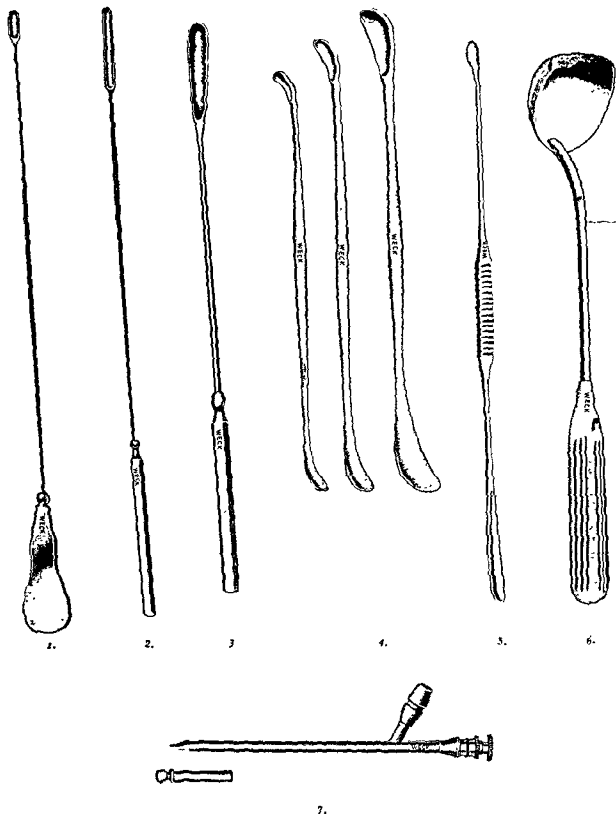


Fig. 322.—Instruments for biliary surgery—cont'd· *1*, Mayo common duct scoop; 2, Mayo cystic duct scoop; *3*, Mayo-Robson *gallstone scoop*; *4*, Ferguson gallstone scoops; *5*, Mayo double-ended gallstone scoop; *6*, Moore's *gallstone spoon*, *7*, Ochsner gall bladder trocar. (Courtesy Edward Weck & Co., Inc., Brooklyn, N. Y.)

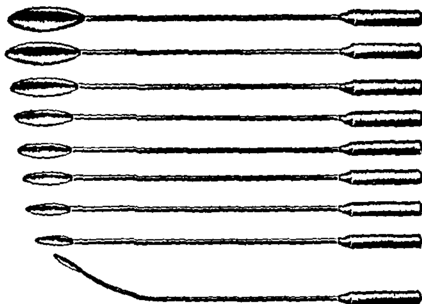


Fig. 323.—Blakés common dust dilators.

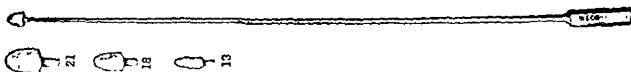
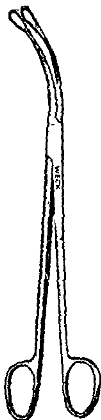


Fig. 324 —Desjardin gallstone probe.



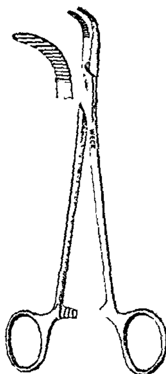


Fig 326 —Rochester gallstone forceps

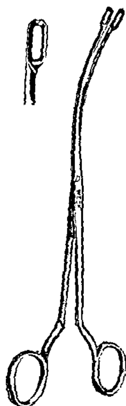


Fig 325.—Blake gallstone forceps.

Fig 327 —Lower gall (cystic) duct forceps

(Courtesy Edward Weck & Co, Inc, Brooklyn, N Y)

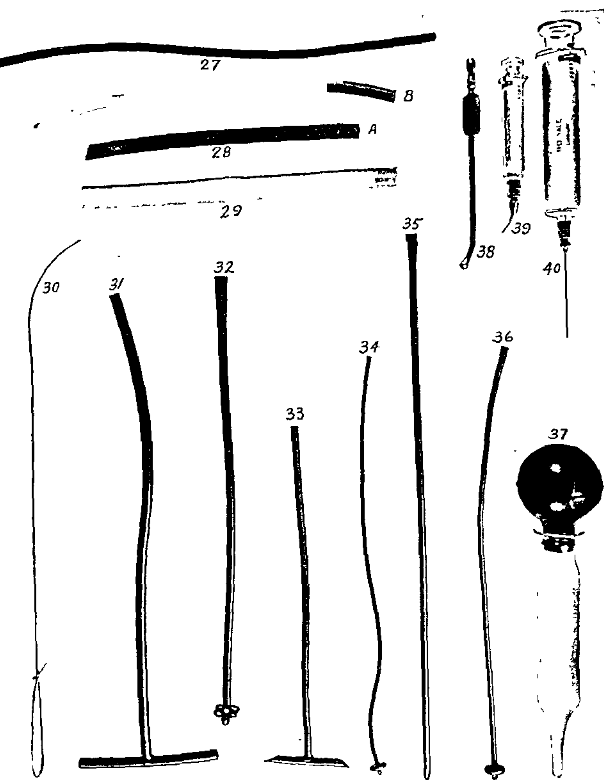


Fig 328—Aspiration set, drainage and suctioning tubes for biliary surgery: *27*, Red rubber tubing, *28*, *A* and *B*, black rubber tubing; *29*, Penrose tubing, *30*, catheter stylet; *31*, T-tube; *32*, Malecot winged catheter; *33*, T-tube cut, *34*, Pezzer closed top catheter; *35*, Robinson catheter, *36*, Pezzer catheter, *37*, Asepto syringe; *38*, sinus irrigating tip, *39*, hypodermic Luer-Lok syringe with cystic duct needle; *40*, Luer-Lok syringe, 20 ml, with long aspirating needle

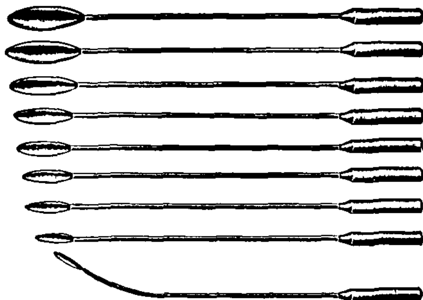


Fig 323.—Blake's common dust dilators.

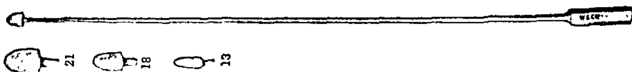


Fig 324 —Desjardin gallstone probe

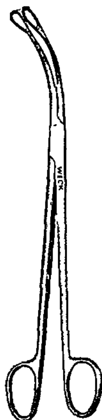


Fig 325 —Blake gallstone forceps

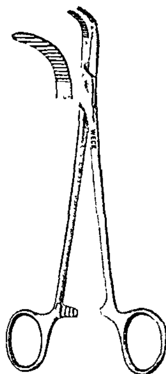


Fig 326 —Rochester gallstone forceps

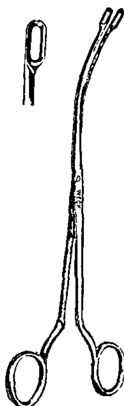


Fig 327 —Lower gall (cystic) duct forceps

(Courtesy Edward Weck & Co, Inc, Brooklyn, N Y)

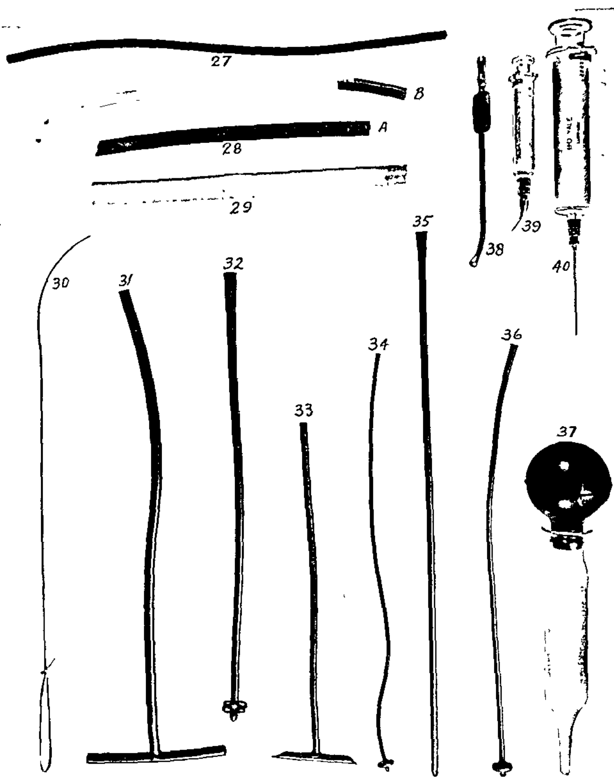


Fig 3?? ... rgery: *27*, Red rubber tubing, *28* ... stylet, *31*, T-tube; *32*, Malecot ... catheter, *35*, Robinson catheter; *36*, Pezzer catheter; *37*, Asepto syringe; *38*, sinus irrigating tip; *39*, hypodermic Luer-Lok syringe with cystic duct needle; *40*, Luer-Lok syringe, 20 ml., with long aspirating needle

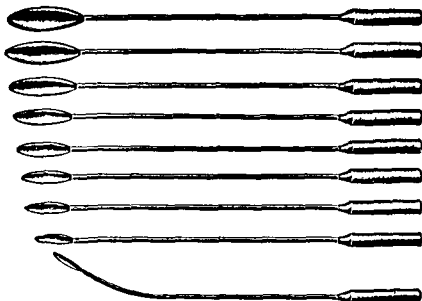


Fig. 323.—Blakés common dust dilators.

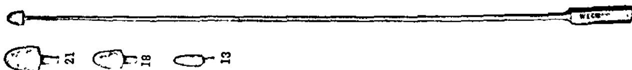


Fig. 324—Desjardin gallstone probe.

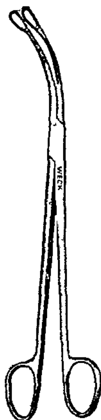


Fig 325—Blake gallstone forceps.

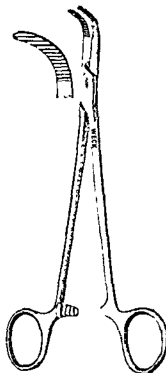


Fig 326—Rochester gallstone forceps

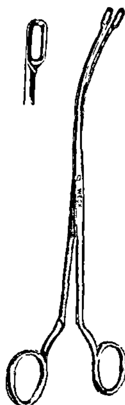


Fig 327—Lower gall (cystic) duct forceps

(Courtesy Edward Weck & Co, Inc, Brooklyn, N. Y.)

support the arm on an armrest (Chapter 4). Attach the padded shoulder pieces to the table and place them one and one-half inches against the outer aspects of the shoulders.

Place his legs slightly apart, with the feet at right angles to the legs. Place a thin pad or folded sheet beneath the popliteal space to relieve strain on the nerves; then place a small pillow under the feet to prevent plantar flexion. If necessary, secure the leg strap around the table and legs at a level above the knees (Fig. 329).

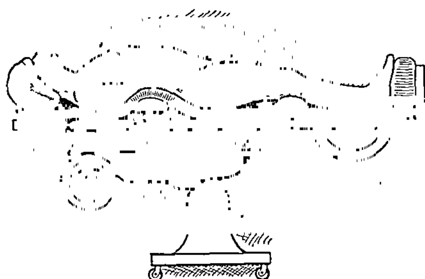


Fig 329—Position of the patient for gall bladder and bile duct surgery. (From Shackelford, R. T: Bickham-Callander Surgery of the Alimentary Tract, Philadelphia, 1955, W. B Saunders Co)

Fold back the lower end of the patient's gown and make sure its fasteners are free; then fold the upper end of the sheet downward onto the pubic region.

Slightly raise the elevator rest, adjust the height of the table to suit the operator's convenience, and focus the operating lamp onto the proposed line of incision.

In some conditions the patient is placed in a reverse Trendelenburg position, which will allow the weight of the liver to slide below the costal margin and the abdominal viscera to fall away from the epigastric region (Chapter 4). If this position is used, the footpiece is attached to the operating table before the patient arrives, and a protective pad is placed between it and the patient's feet. The table is tilted downward so that the head is higher than the feet, and the height of the table is adjusted to suit the operator's convenience (Chapter 7).

SKIN PREPARATION AND DRAPING PROCEDURE

Skin cleansing procedures have been described in Chapter 3. For biliary operations the proposed operative area usually includes the chest region at a level above the nipples, and the entire abdomen, down to the upper pubic region (Figs. 12 and 263). Aseptic draping procedures are described in Chapter 4 and

1 Thorek gall bladder aspirator, including 10 ml. Luer-Lok syringe, 2-way stopcock, curved connection tube, and trocar and bottle, if desired
1 Desjardin gallstone probe (Fig. 324)
1 Mayo-Harrington or Mixter scissors, 8½ inches
2 Tissue forceps or Harrington-Mayo forceps without jaws, 8 inches
1 Mayo-Hegar needle holder, 7 inches

Drainage

3 Pieces of black rubber tubing, 12 inches, various lumen diameters
2 Penrose drains, ⅝- or ½-inch diameter, each 8 inches (Fig. 328)
½ Yard plain gauze packing, 2 inches wide
1 Pezzer catheter No. 24 or 28 F or Robinson catheter No. 18 or 22 F
1 Glass elbow

Sutures

Celiotomy needle set plus:
Chromic and plain gut Nos. 1, 0, and 2-0
Silk Nos. 0 and 2-0
Chromic gut No. 2-0 or silk Nos. 0 and 2-0
Swaged-on suture needles

Textiles

Major operating pack
6 Laparotomy pads, large size
6 Laparotomy pads, medium size
1 Gown set
1 Glove set

POSITIONING THE PATIENT FOR BILIARY SURGERY

The posture of the patient on the operating table must provide for adequate exposure of the proposed operative site without causing bodily harm (Chapter 4).

Items.—The pieces of equipment include the following:

Modern operating table
Anesthetist's screen
Lift sheet
Leg strap
Two small pillows
Narrow sponge-rubber pad
Armrest with restraint
Footpiece for reverse Trendelenburg

Procedure.—The circulating nurse must have all pieces of equipment ready for use. She must adjust the operating lamp, test all lamps, then turn them off. The table is placed outside the operating unit. The circulating nurse greets the patient, assists in positioning the patient on the operating table, and gives him the assurance he needs at this time, if he is awake. The nurse checks the patient's chart for written reports according to the operating room rules for admitting a patient to surgery.[8,11-14]

When the patient is transferred to the operating able, place him in a supine position, with the costal margin over the table's elevator rest, and place a pillow under his head and shoulders; have a skin area against table pad.

Secure the leg strap to the table and over his legs at a point just above the knees. Stay with him during the induction of the anesthetic. After he is asleep, unfasten the leg strap; make sure the costal region is over the rest.

Adjust the lift sheet under his back and place a small sheet or thin foam-rubber pad under the lumbar curvature, unless contraindicated; then place another thin pad under the costal region, if desired.

Secure his forearms and hands in the folds of the lift sheet, with his elbows slightly flexed, palms downward, fingers straight, and thumbs slightly abducted.[11] If intravenous fluids are to be injected through a vein in the arm, extend and

support the arm on an armrest (Chapter 4). Attach the padded shoulder pieces to the table and place them one and one-half inches against the outer aspects of the shoulders.

Place his legs slightly apart, with the feet at right angles to the legs. Place a thin pad or folded sheet beneath the popliteal space to relieve strain on the nerves; then place a small pillow under the feet to prevent plantar flexion. If necessary, secure the leg strap around the table and legs at a level above the knees (Fig. 329).

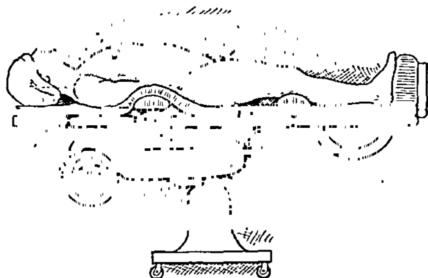


Fig 329—Position of the patient for gall bladder and bile duct surgery. (From Shackelford, R. T.: Bickham-Callander Surgery of the Alimentary Tract, Philadelphia, 1955, W. B. Saunders Co)

Fold back the lower end of the patient's gown and make sure its fasteners are free; then fold the upper end of the sheet downward onto the pubic region.

Slightly raise the elevator rest, adjust the height of the table to suit the operator's convenience, and focus the operating lamp onto the proposed line of incision.

In some conditions the patient is placed in a reverse Trendelenburg position, which will allow the weight of the liver to slide below the costal margin and the abdominal viscera to fall away from the epigastric region (Chapter 4). If this position is used, the footpiece is attached to the operating table before the patient arrives, and a protective pad is placed between it and the patient's feet. The table is tilted downward so that the head is higher than the feet, and the height of the table is adjusted to suit the operator's convenience (Chapter 7).

SKIN PREPARATION AND DRAPING PROCEDURE

Skin cleansing procedures have been described in Chapter 3. For biliary operations the proposed operative area usually includes the chest region at a level above the nipples, and the entire abdomen, down to the upper pubic region (Figs. 12 and 263). Aseptic draping procedures are described in Chapter 4 and

illustrated in Figs. 86 to 91. Incisions are described in Chapter 11 and illustrated in Fig. 266.

When a right paramedian incision is to be used (Fig. 267), a prepared rectangular skin area is excluded by placing four towels as follows: The draper stands at the right side of the table and places the folded side of one towel transversely over the abdomen at a level of one and one-half inches below the umbilicus. The folded edge of a second towel is placed transversely and parallel to the first towel at a level with the lower portion of the sternum, and the remaining part of the towel falls over the upper chest region. The folded edge of a third towel is placed longitudinally on the right lateral side at a right angle to the other two towels (Fig. 90). A fourth towel is placed longitudinally on the left side parallel to the third towel and on a line with the umbilicus (Chapter 4).

For a transverse (subcostal) incision (Fig. 268), the folded edge of the first towel is placed across the abdomen at a level of two inches above the umbilicus. The second cuffed towel is placed transversely over the upper abdomen, covering the area over the lower portion of the sternum and parallel to the first towel. The third and fourth towels are placed longitudinally at a level within the anterior axillary line on each side and at right angles to the first and second towels and parallel to each other. The laparotomy sheet is draped over the patient as described and illustrated in Chapter 4.

PREVENTIVE NURSING MEASURES

Proper preoperative skin preparation, correct positioning of the patient, and adequate and safe draping procedures are essential to ensure the safety of the patient and provide for adequate exposure of the proposed operative site (Chapters 4 and 11).

Drainage catheters or tubes must be in perfect condition and suitable to the duct or organ to be drained (Fig. 328). If a worn or damaged tube is used, a piece may remain in the wound when the tube is being removed. To drain the gall bladder bed, the tube must be of sufficient length, and the distal end of the tube or catheter should be beveled and should have several lateral openings near its tip. To make certain a tube is patent, the scrubbed nurse flushes it with normal saline solution, using an Asepto syringe. Long tissue forceps without teeth are also needed to introduce the drainage tube or catheter into the cavity or duct.

In duct operations the correct types and appropriate sizes of tubes should be sterile, ready for use The surgeon selects the size of the tube and cuts the length of a T-tube's crossbar after he has explored the ducts. In a choledochostomy the tube's crossbar is usually two or three inches long, and its ends are generally cut on a bevel to facilitate easy removal. The center of the crossbar is usually notched opposite the junction of the vertical limb so that its ends will bend more readily as the tube is being removed. In operations involving the ampulla of Vater, the T-tube's distal crossbar should be long enough to pass through this sphincter and into the duodenum, if so desired

A Luer-Lok syringe attached to a short beveled angular needle is needed to aspirate a bile duct. A bile specimen is aspirated into a sterile culture tube. For irrigation of the ducts, the scrubbed nurse should have a small-sized urethral catheter ready, an Asepto syringe filled with normal saline solution at 100° F., and a slender suction cannula attached to the suction tubing (Fig. 328).

When an anastomosis is to be established between a duct and an organ, aseptic techniques are followed, as described for gastrointestinal surgery in Chapter 12.

Before the patient arrives the circulating nurse should assemble the sterile solutions and drugs and the pieces of equipment for administering them. She should check the cardiac arrest tray and arrange the patient's x-ray pictures in the room. If cholangiograms are to be taken, the necessary equipment must be ready for use.[8, 15-17]

OPERATIONS

Cholecystectomy

Definition.—Through a right rectus, transverse, or subcostal abdominal incision, the gall bladder is removed.

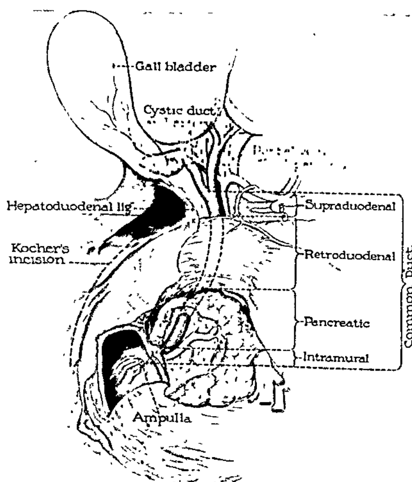


Fig. 330.—Semidiagrammatic illustration showing details of surgical anatomy of extrahepatic biliary tree. Kocher's incision. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N. J.)

Considerations.—A cholecystectomy is done for the treatment of diseases involving the gall bladder, such as acute or chronic inflammation with or without stones (cholelithiasis), or in the presence of polyps or carcinoma.[8-10,14,16,18]

Setup, Preventive Measures, Position, Skin Preparation, and Draping Procedure.—As described for biliary surgery, plus setup listed for cholecystectomy and illustrated in Figs. 321 to 328.

Operating Procedure.—The items generally used to perform a cholecystectomy are listed opposite each step.

Steps	*Items*
1. The abdominal cavity is opened through a right rectus incision or through a transverse (subcostal) incision (Figs. 264 to 268).	1. As described for celiotomy (Chapter 11)
2. The peritoneal cavity is retracted and explored. Surrounding organs are walled off from the gall bladder region (Fig. 331).	2. Richardson, Deaver, or Kelly retractors, long tissue or bayonet forceps, moist packs, sponges on holders
3. The peritoneal fold (ligamentum falciforme hepatis) is clamped, divided, and retracted; adherent adhesions are separated. Common duct is palpated for evidence of stones (Fig. 318).	3. Ochsner straight or Pean curved hemostats, long Mayo-Harrington or Mayo scissors, long tissue forceps, chromic gut No. 0 or silk No. 2-0 on Murphy, ½-circle taper-point needle No. 3 or swaged-on needles
4. The fundus of the gall bladder is grasped and pulled upward and forward. Dissection is carried out, exposing the neck of the gall bladder and the cystic duct (Fig. 331).	4. Ochsner, Pean, or long Judd-Allis forceps, moist packs, tissue forceps, Metzenbaum or Harrington scissors, sponges on holders, blade retractor
5. The ampulla of the gall bladder is clamped just above the cystic duct.	5. Mixter, Gray, or Lower forceps, Pean hemostats, 8 inches
6. Both the cystic duct and cystic artery are doubly and separately clamped, divided, and ligated near the common duct. Bleeding vessels are ligated.[18, 19]	6. Moynihan, Lower, or Gilbert forceps, suction set, long scissors, chromic gut No. 1 or 0 on needle, ligatures, chromic gut Nos. 0 and 2-0, Mayo-Pean forceps, Mayo scissors
7. The gall bladder is removed; the fossa may be closed.	7. Long knife and scissors, suction set, chromic gut No. 2-0 and needle combination, needle holder, long tissue forceps with 1 and 2 teeth, dressing forceps, sponges on holders, irrigation set
8. A drain is inserted.	8. Cigaret drain or black rubber tube, bayonet or tissue forceps
9. The wound is closed and dressed.	9. As for celiotomy closure (Chapter 11)

Cholecystostomy

Definition.—Establishment of an opening into the gall bladder to permit drainage of the organ and the removal of stones.

Considerations.—Cholecystostomy may be performed in those patients whose physical condition will not permit more extensive surgery.

Setup, Preventive Measures, Position, Skin Preparation, and Draping Procedure.—As described previously for biliary surgery, including setup listed for cholecystectomy. Other factors are discussed in previous chapters, skin preparation in Chapter 3, positioning and draping the patient in Chapter 4, and suture materials in Chapter 5.

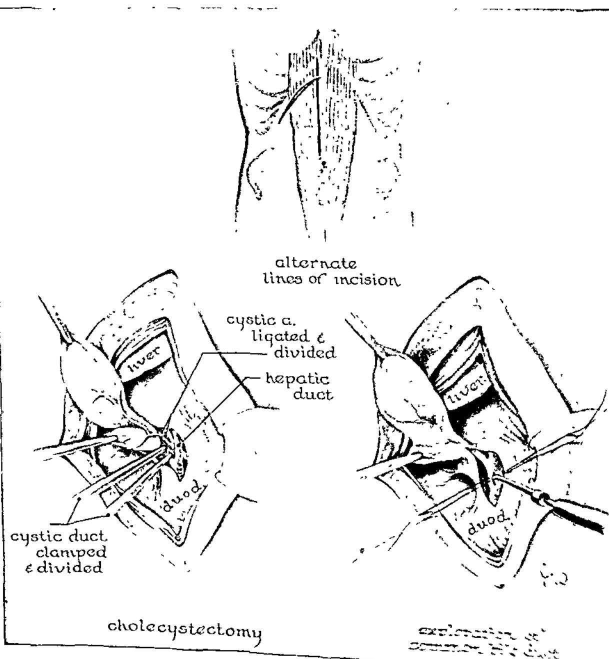


Fig 331.—Technique of cholecystectomy [illegible]. [illegible] book of Surgery, St. Louis, [illegible]

Operative Procedure.—

Steps	*Items*
1. The abdomen is opened.	1. As described for cholecystectomy
2. The fundus of the gall bladder is grasped and a purse-string suture placed around the proposed opening in the fundus.	2. Chromic gut No. 0, swaged-on needle, needle holder, tissue forceps, hemostats, scissors
3. The trocar is inserted into the gall bladder and its contents aspirated. Cultures may be taken. All soiled instruments are placed in a basin on the operative field. (Fig. 331.)	3. Ochsner cannula and trocar suction set, laparotomy pads, culture tubes, basin, sponges on holders
4. The trocar is removed, the opening is enlarged, and the gallstones are removed.	4. Scissors, stone scoops and gallstone forceps
5. A rubber tube or a catheter is inserted into the gall bladder opening; then the purse-string suture is tightened around the tube. A second suture may be inserted. The drainage tube may be brought out through a stab wound. The wound is closed and dressed.	5. Desired catheter, Asepto syringe, scissors, scalpel, chromic gut suture, swaged-on needle, tissue forceps; items for closure of celiotomy (Chapter 11)

Choledochostomy and Choledochotomy

Definitions.—The establishment of an opening into the common bile duct by means of a drainage T-tube. A choledochotomy is the actual incision into *the common bile duct for removal of stones.*

Purpose.—To treat choledocholithiasis or to relieve an obstruction in the common bile duct.[5,9,16,20,21]

Setup, Preventive Measures, Position, Skin Preparation, Draping Procedure, and Incision.—As described for biliary operations. A celiotomy setup (Chapter 11), plus special instruments as follows:

1 Mayo cystic duct scoop, malleable, 10½ inches
1 Mayo common duct scoop, malleable, 10½ inches
1 Ochsner spiral gallstone probe, pliable, 14 inches
1 set Bakes common duct dilators, malleable
1 Mixter gallstone forceps, 6½ inches, angular
2 Mayo-Blake gallstone forceps, curved and straight, 8 inches
1 Moynihan gallstone probe and scoop, pliable block tin, 13 inches
4 Allis tissue intestinal forceps, 5 and 6 teeth, 7½ inches, straight
1 20 ml. syringe with aspirating needles—1 gauge 19, 3½ inches; 1 gauge 24, ¾ inches, angular
1 Asepto syringe, 2 ounces
1 Lundy syringe with Rochester-Meeker wheal needle, gauge 24 by ¾ inches, optional
3 T-tubes, crossbar 4½ inches, length 11 inches, sizes 12, 18, 20, 24 F, as desired
3 Robinson catheters, sizes 10, 12 and 14 F

Operative Procedure for Choledochotomy.—

Steps	*Items*
1. The abdomen is opened, the gall bladder retracted and the common duct exposed.	1. As described for celiotomy (Chapter 11)
2. The common duct is mobilized and aspirated to make certain that the suspected duct is not a blood vessel (Fig. 318).	2. Intestinal forceps, syringe and aspirating needle, 2 small laparotomy pads, small basin, culture tube
3. Traction sutures are placed in the wall of the duct below the entrance of the cystic duct. The common duct region is walled off with moist small packs.	3. Narrow blade retractor, silk No. 3-0, cotton or chromic gut No. 2-0 attached to ½-circle taper-point needle, needle holders, Crile hemostat, hemostats for holding sutures, tissue forceps, straight scissors, small packs, thumb forceps
4. A longitudinal incision is made in the common bile duct between the traction sutures. Suction set is used	4. Long-handled scalpel with blade No. 15 or Mayo ureteral knife, inner part of Pool suction or Yankauer tube, long tissue forceps 1 and 2 teeth, Metzenbaum scissors, small sponges on holders, blade retractors, moist small laparotomy pads
5 Both the common bile duct and the hepatic ducts are explored, probed, and dilated. Stones are removed.	5. Malleable probes, gallstone scoops and forceps, Bakes dilators, syringe and basin, sponges on holders
6. The common bile duct is irrigated upward and downward by inserting a catheter into its lumen.	6. Robinson catheter, Asepto syringe, normal saline solution, small basin, suction set, small laparotomy pads, common duct scoops
7. The duodenum may be opened for visualization of the ampulla of Vater or the sphincter of Oddi or for removal of stones (Fig. 330).	7. Malleable probe and scoop, long knife, No. 15 or 11 blade, suction set, traction sutures—silk or chromic gut No. 2-0, needle holders, Crile forceps
8. The gall bladder may be removed.	8. As described for cholecystectomy (Fig. 331)
9. A T-tube is passed into the duodenum and duct if a transduodenal sphincterotomy has been done, or if the gall bladder has been removed, a tube is inserted through the cystic duct stump into the common duct.	9. T-tube inspected, tested, and prepared; long tissue forceps without teeth, scissors, sponges on holders

Operative Procedure.—

Steps	*Items*
1. The abdomen is opened.	1. As described for cholecystectomy
2. The fundus of the gall bladder is grasped and a purse-string suture placed around the proposed opening in the fundus.	2. Chromic gut No. 0, swaged-on needle, needle holder, tissue forceps, hemostats, scissors
3. The trocar is inserted into the gall bladder and its contents aspirated. Cultures may be taken. All soiled instruments are placed in a basin on the operative field. (Fig. 331.)	3. Ochsner cannula and trocar suction set, laparotomy pads, culture tubes, basin, sponges on holders
4. The trocar is removed, the opening is enlarged, and the gallstones are removed.	4. Scissors, stone scoops and gallstone forceps
5 A rubber tube or a catheter is inserted into the gall bladder opening; then the purse-string suture is tightened around the tube. A second suture may be inserted. The drainage tube may be brought out through a stab wound. The wound is closed and dressed	5. Desired catheter, Asepto syringe, scissors, scalpel, chromic gut suture, swaged-on needle, tissue forceps; items for closure of celiotomy (Chapter 11)

Choledochostomy and Choledochotomy

Definitions.—The establishment of an opening into the common bile duct by means of a drainage T-tube. A choledochotomy is the actual incision into the common bile duct for removal of stones.

Purpose.—To treat choledocholithiasis or to relieve an obstruction in the common bile duct.[5,9,16,20,21]

Setup, Preventive Measures, Position, Skin Preparation, Draping Procedure, and Incision.—As described for biliary operations. A celiotomy setup (Chapter 11), plus special instruments as follows:

1 Mayo cystic duct scoop, malleable, 10½ inches
1 Mayo common duct scoop, malleable, 10½ inches
1 Ochsner spiral gallstone probe, pliable, 14 inches
1 set Bakes common duct dilators, malleable
1 Mixter gallstone forceps, 6½ inches, angular
2 Mayo-Blake gallstone forceps, curved and straight, 8 inches
1 Moynihan gallstone probe and scoop, pliable block tin, 13 inches
4 Allis tissue intestinal forceps, 5 and 6 teeth, 7½ inches, straight
1 20 ml syringe with aspirating needles—1 gauge 19, 3½ inches; 1 gauge 24, ¾ inches, angular
1 Asepto syringe, 2 ounces
1 Lundy syringe with Rochester-Meeker wheal needle, gauge 24 by ¾ inches, optional
3 T-tubes, crossbar 4½ inches, length 11 inches, sizes 12, 18, 20, 24 F, as desired
3 Robinson catheters, sizes 10, 12 and 14 F

Setup, Preventive Measures, Skin Preparation, Position, Draping Procedure, and Incision.—As described for biliary surgery, including the setup listed for cholecystostomy, adding the following:

12 Extra Crile or Johns Hopkins hemostats, straight, 6¼ inches
4 Allis forceps, 5 and 6 teeth, 7¼ inches, Lockwood-Allis, 5 and 6 teeth, 7¾ inches, or Judd-Allis intestinal forceps, 6¼ inches
2 Doyen or Thomas-Smith intestinal forceps, curved blades, with rubber guards, or bladed blood vessel clamps for lateral anastomosis
12 Kelly hemostats, curved, Hegar needle holder, 7¼ inches

Operative Procedure.—The patient is placed on the operating table as described for biliary surgery (Fig. 329). Routine skin preparation and draping procedure as described for celiotomy are carried out (Chapters 3, 4, and 11).

Steps	*Items*
1. The abdomen is opened; the gall bladder is exposed and mobilized.	1. As described for cholecystostomy (Fig. 331)
2. The gall bladder is aspirated and drained and the puncture wound clamped.	2. Ochsner trocar and cannula, suction set, moist small laparotomy pads, curved Ochsner or Mayo hemostats, kidney basin
3. A portion of the stomach is approximated to the gall bladder near the fundus; the serosal layers of the two organs are sutured, posteriorly. Sutures on either end are left long. The stomach and gall bladder at site of anastomosis may be clamped. Laparotomy pads are placed beneath proposed site for the anastomosis.	3. Allis intestinal forceps, chromic gut or silk No. 2-0 swaged to needles, needle holders, straight hemostats, tissue forceps, 2 small packs, Doyen or Thomas-Smith curved rubber-shod intestinal clamps or blood vessel clamps
4. Incisions are made into the gall bladder and the stomach; bleeding vessels are clamped and ligated; wound is suctioned.	4. As described for open anastomosis of small intestine (Chapter 12), scalpel, Metzenbaum scissors, long tissue forceps, suction set, curved hemostats, sponges on holders, silk or chromic gut No. 2-0 or 3-0 for ligatures.
5. The mucosal layers are closed posteriorly and anteriorly by continuous suture.	5. Chromic gut No. 2-0 or 3-0, long suture attached to ½-circle intestinal needle, long needle holder, long tissue forceps, suction set
6. An anterior row of sutures is placed joining the serosal layers.	6. Silk, cotton, or chromic gut No. 2-0 or 3-0 for interrupted sutures, 2 needle holders, 2 tissue forceps with 1 and 2 teeth, 2 tissue forceps without teeth
7. The wound is closed in layers. Dressings are applied.	7. As in celiotomy (Chapter 11)

Steps	Items
10. The duct is closed around the tube. The drainage tube is inserted into the cavity.	10. Chromic gut No. 2-0 swaged-on needle, needle holder, long tissue forceps, Asepto syringe and saline solution, suction set, pads, towel, basin; black rubber tube or cigaret Penrose drain
11. The abdominal wound is closed and the T-tube anchored to the skin by a tension suture. Dressings are applied to the wound.	11. As described for closure of celiotomy (Chapter 11)

Cholecystogastrostomy or Cholecystoduodenostomy

Definition.—*Establishment of a fistula (anastomosis) between the gall bladder* and the stomach or between the gall bladder and the duodenum (Fig. 332).

Considerations.—An obstruction in the biliary system may be caused by a tumor of the ducts involving the head of the pancreas or the ampulla of Vater. The obstruction may be due to the presence of an inflammatory lesion or a stricture of the common duct.[5,13,20]

Purpose.—To relieve an obstruction situated in the distal end of the common duct.

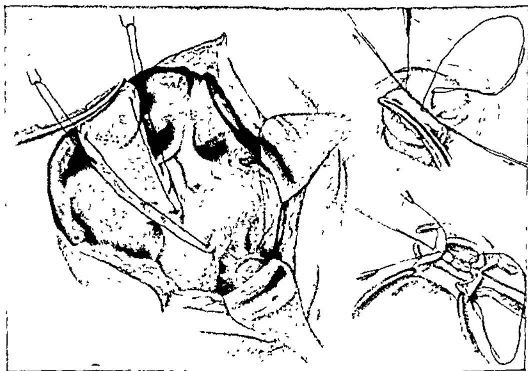


Fig. 332.—Technique for cholecystenerostomy The gall bladder has been emptied with trocar and cannula, and the opening temporarily closed with a forceps The tractor sutures are placed between the duodenum and gall bladder The duodenum and gall bladder may be clamped with soft-bladed forceps. The gall bladder is generally sutured with fine chromic gut sutures with swaged-on needles. An incision has been made in the gall bladder and duodenum The posterior margin of the wound in the gall bladder is sutured to the posterior margin of the incision in the duodenum with fine chromic gut or silk sutures. (From Horsley, G. W., and Bigger, I A · Operative Surgery, vol II, St Louis, 1953, The C V Mosby Co)

Setup, Preventive Measures, Skin Preparation, Position, Draping Procedure, and Incision.—As described for biliary surgery, including the setup listed for cholecystostomy, adding the following:

12 Extra Crile or Johns Hopkins hemostats, straight, 6¼ inches
4 Allis forceps, 5 and 6 teeth, 7¼ inches, Lockwood-Allis, 5 and 6 teeth, 7¾ inches, or Judd-Allis intestinal forceps, 6¼ inches
2 Doyen or Thomas-Smith intestinal forceps, curved blades, with rubber guards, or bladed blood vessel clamps for lateral anastomosis
12 Kelly hemostats, curved, Hegar needle holder, 7¼ inches

Operative Procedure.—The patient is placed on the operating table as described for biliary surgery (Fig. 329). Routine skin preparation and draping procedure as described for celiotomy are carried out (Chapters 3, 4, and 11).

Steps	*Items*
1. The abdomen is opened; the gall bladder is exposed and mobilized.	1. As described for cholecystostomy (Fig. 331)
2. The gall bladder is aspirated and drained and the puncture wound clamped.	2. Ochsner trocar and cannula, suction set, moist small laparotomy pads, curved Ochsner or Mayo hemostats, kidney basin
3. A portion of the stomach is approximated to the gall bladder near the fundus; the serosal layers of the two organs are sutured, posteriorly. Sutures on either end are left long. The stomach and gall bladder at site of anastomosis may be clamped. Laparotomy pads are placed beneath proposed site for the anastomosis.	3. Allis intestinal forceps, chromic gut or silk No. 2-0 swaged to needles, needle holders, straight hemostats, tissue forceps, 2 small packs, Doyen or Thomas-Smith curved rubber-shod intestinal clamps or blood vessel clamps
4. Incisions are made into the gall bladder and the stomach; bleeding vessels are clamped and ligated; wound is suctioned.	4. As described for open anastomosis of small intestine (Chapter 12), scalpel, Metzenbaum scissors, long tissue forceps, suction set, curved hemostats, sponges on holders, silk or chromic gut No. 2-0 or 3-0 for ligatures.
5. The mucosal layers are closed posteriorly and anteriorly by continuous suture.	5. Chromic gut No. 2-0 or 3-0, long suture attached to ½-circle intestinal needle, long needle holder, long tissue forceps, suction set
6. An anterior row of sutures is placed joining the serosal layers.	6 Silk, cotton, or chromic gut No. 2-0 or 3-0 for interrupted sutures, 2 needle holders, 2 tissue forceps with 1 and 2 teeth, 2 tissue forceps without teeth
7. The wound is closed in layers. Dressings are applied.	7. As in celiotomy (Chapter 11)

Choledochoduodenostomy or Hepaticoduodenostomy

Definition.—Anastomosis between the common duct and the duodenum (choledochoduodenostomy); or anastomosis between the hepatic ducts and duodenum (hepaticoduodenostomy).

Purpose.—To circumvent an obstructive lesion. It is usually necessary in patients who have had a cholecystectomy.[5,8,9,11]

Setup, Preventive Measures, Position, Skin Preparation, and Draping Procedure.—As described for biliary surgery. The setup includes the items listed for biliary surgery and specific instrument including:

1 Mayo cystic duct scoop, malleable
1 Mayo common duct scoop, malleable (Fig. 322)
6 Common duct dilators, various sizes
1 Mixter gallstone forceps, angular jaws
2 Mayo-Blake gallstone forceps, 8 inches (Fig. 325)
1 Moynihan gallstone probe and scoop (Fig. 323)

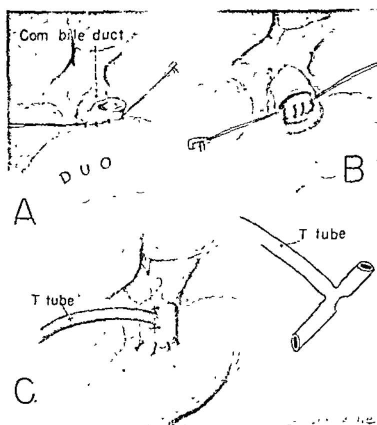


Fig 333.—Choledochoduodenostomy end to side anastomosis. *A*, Serosal coat of duodenum and common duct sutured. *B*, Opening made in the duodenum and the mucosa of the duodenum and common duct sutured. *C*, Anastomosis complete and T-tube in place. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, vol. II, St. Louis, 1953, The C. V. Mosby Co.)

Operative Procedure for Choledochoduodenostomy.—

1. The wound is opened, the gall bladder and duodenum are exposed as in cholecystectomy.

2. The common duct is identified by aspiration and dissected free as described for choledochotomy.

3. The common duct and duodenum are approximated and the anastomosis established as described for cholecystogastrostomy (Fig. 333).

4. The wound is closed as described for closure of celiotomy (Chapter 11).

Operative Procedure for Hepaticoduodenostomy.—The abdomen is opened as described for celiotomy; the duodenum is mobilized, and the hepatic ducts are identified. An opening is made in the duodenum, and an anastomosis is established between the hepatic ducts and the duodenum. A T-tube is inserted as described for cholecystogastrostomy. The wound is closed in layers as described for closure of celiotomy (Chapter 11).

Repair of Strictures of the Common and Hepatic Ducts

Definition.—Resection or by-pass of the stricture with re-establishment of biliary continuity by means of an anastomosis between the dilated duct or ducts and the intestinal tract.[6,8,17,22]

Setup Position, Skin Preparation, Draping Procedure, and Incision.—As described for biliary surgery. The setup includes the items listed for biliary surgery, plus the following:

- 6 Mayo-Pean hemostats, curved, 8 inches
- 12 Crile or Johns Hopkins hemostats, straight, 6¼ inches
- 4 Lockwood-Allis or Judd-Allis forceps
- 2 Doyen or Thomas-Smith intestinal forceps with rubber guards
- Vitallium tubes, if desired
- Split or double-end tubes, desired type and size
- T-tubes with crossbar, 4½ to 8 inches, various sizes (Fig. 328)
- Urethral catheters Nos. 10, 12, 16, and 22 F
- 4 Silk and chromic gut sutures, No. 2-0 or 3-0, attached to needles
- For partial hepatectomy and cholangiojejunostomy, and hemostatic substance

Operative Procedure.—The abdomen is opened and the affected duct is exposed as described for choledochoduodenostomy (Fig. 333).

The selected tube is inserted and the anastomosis completed over the tube. The wound is closed as described for celiotomy (Chapter 11).

Pancreatoduodenectomy

Definition.—Removal of the head of the pancreas, the entire duodenum, a portion of the jejunum, the distal third of the stomach, the lower half of the common bile duct, and a portion of the pancreatic duct, and the re-establishment of continuity of the biliary, pancreatic, and gastrointestinal tract systems.[14,16,23]

Considerations.—Pancreatoduodenectomy may be done in a one- or two-stage operation. The patient's condition will determine the method adopted, although the one-stage operation is preferable.[16,22,23]

Setup, Preventive Measures, Position, Skin Preparation, and Draping Procedure.—As described previously for biliary surgery. Basic biliary setup is used, plus the following:

4 Judd-Allis forceps, 7½ inches
4 Rochester-Carmalt hemostats, curved, 8 inches
6 Mayo-Pean hemostats, curved, 8 inches
2 Masson or Nelson long needle holders, 10 inches
1 Nelson dissecting scissors, 9 inches
2 Scudder or Doyen rubber-shod intestinal clamps
2 Allen or 4 Ochsner clamps, 8 inches
2 Mixter gall duct forceps, jaws 3½ inches

Operative Procedure (One-Stage).—

1. The peritoneal attachment of the duodenum is divided; the duodenum is retracted to explore the portal vein and the mesenteric system and to determine the extent of the lesion (Fig. 319).

2. The stomach is divided between clamps with cautery (Chapter 12).

3. The lower end of the common duct is divided between gall bladder angled clamps as described for choledochotomy. Gastroduodenal arteries are clamped, doubly ligated, and divided.

4. The neck of the pancreas is exposed and divided between angled clamps or curved Mayo-Pean forceps or intestinal clamps. The tissues are dissected from the surface of the pancreas; the inferior pancreatoduodenal vessels are clamped, ligated, and divided.

5. The blood vessels of the duodenum and the upper jejunum are clamped, ligated, and divided; then the duodenum and a portion of the jejunum are resected.

6. An end-to-end anastomosis is completed between the cut end of the pancreas and the jejunum, as described for gastrointestinal anastomosis.

7. An end-to-side choledochojejunostomy is completed between the common duct and the jejunum by two or three rows of silk sutures, and a gastrojejunostomy may be performed between the open end of the stomach and the jejunum.

8. The mesentery of the colon is sutured around the jejunum and stomach. The wound is drained and closed in layers, as described for celiotomy (Chapter 11).

Transduodenal Sphincterotomy

Definition.—Partial division of the sphincter of Oddi, and exploration of the common duct.

Purpose.—To treat recurrent attacks of acute pancreatitis due to the formation of calculi in the pancreatic duct or blockage of the sphincter of Oddi.[9, 15]

Setup, Position, Draping Procedure, and Incision.—As described for biliary surgery. Basic setup listed for biliary surgery, plus the following:

4 Judd-Allis forceps
4 Allis forceps, 5 and 6 teeth, 7¼ inches
1 Ureter knife or sphincterotome

Operative Procedure.—

1. The gall bladder may have been removed; the common duct is opened and explored for stones, as described for choledochotomy.
2. For Doublet and Mulholland technique, a sphincterotome is inserted through the common duct into the duodenum and the sphincter severed; or the ampulla of Vater is exposed through an incision made in the duodenum, and a probe is passed through the common duct into the duodenum. The sphincter is incised over the probe.
3. The duodenum is closed with interrupted silk sutures. A T-tube is introduced into the common duct and held in place with sutures. The abdominal cavity is drained and the wound closed, as described in celiotomy (Chapter 11).

Drainage of Liver, Subhepatic or Subphrenic Abscess

Definition.—Drainage of the liver or one or more abscesses situated in the right upper quadrant.

Considerations.—Hepatic abscesses may be pyogenic, single or multiple. The pyogenic and secondary amebic types are generally treated by surgery.[3,5,9,10,24]

The incision and procedure will depend upon the type of abscess and its location. For the anterior approach, a right transperitoneal incision is used.

Setup, Preventive Measures, Position, Skin Preparation, and Draping Procedure.—As described for biliary surgery. For posterior approach the patient is prepared as for posterior thoracostomy (Chapter 9). For anterior appoach, the patient is placed on the operating table in a supine position, with the right side elevated slightly.

Operative Procedure.—Drainage of an abscess may be treated in one or two stages. In the one-stage procedure, the approach is through the outer third of the right twelfth rib, reaching the liver abscess retroperitoneally.

A two-stage operation may be selected to obliterate the right pleural cavity. The first stage aims to seal off the pleural cavity by stimulating adhesions with the insertion of iodoform packing; then when the second operation, which is done at a higher level, is performed, the chest cavity will not become contaminated.

Splenectomy

Definition.—Removal of spleen.

Considerations.—A splenectomy is generally done to treat traumatic rupture or specific conditions of the blood which are associated with a diseased spleen[9, 25-28]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for biliary surgery. The setup listed previously for biliary surgery is needed, with the omission of scoops and dilators. Additional items include the following:

Gauze rollers or folded plain packing
Iodoform packing, if desired
Adrenalin solution
Infusion and blood setup
Hemostatic substances, desired type

The patient is placed on the operating table in either a supine or gall bladder position as described for biliary surgery. The left side of the operating table may be tilted upward. The proposed operative site is cleansed, surrounded by four towels, and the patient draped with a laparotomy sheet (Chapters 3, 4, and 11).

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. Through a long left rectus or oblique subcostal incision the peritoneum is opened.	1. As described for celiotomy opening (Chapter 11)

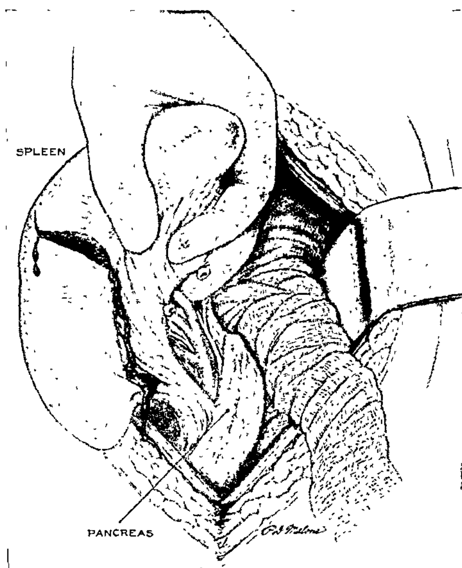


Fig 334.—Emergency splenectomy Exposure of the spleen and ligation of splenic artery. (From Sedgwick, C F S Clin North America 36:725, 1956)

Steps	*Items*
2. The peritoneum is incised (Fig. 320). The costal margin is retracted upward. The stomach and transverse colon are exposed and the fundus of the stomach is retracted toward the midline (Fig. 335).	2. Two tissue forceps, Mayo-Pean hemostat, curved scissors, laparotomy pads, Deaver or Richardson retractors, long tissue forceps without teeth, sponges on holders, suction set
3. The attachments between the surface of the spleen, the parietal peritoneum, and the diaphragmatic attachments are separated.	3. Metzenbaum scissors, scalpel, Mayo-Pean hemostats, sponges on holders, long hemostats, Harrington or Nelson scissors, sponges on holders, chromic gut No. 0 or silk No. 2-0 for ligatures, Mayo scissors
4. The spleen is delivered into the wound. The cavity formerly occupied by the spleen is packed, if necessary.	4. 2 moist laparotomy pads or packing may be used
5. The upper attachments of the spleen to the fundus of the stomach are divided (Fig. 335).	5. Long Mayo-Pean hemostats, sponges on holders, long chromic No. 0 or silk No. 2-0 or 0 for ligatures

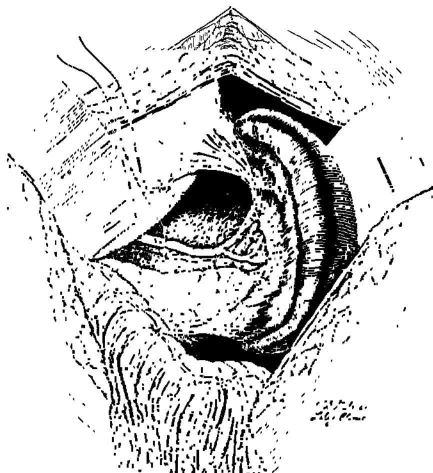


Fig. 335.—Elective splenectomy. (From Sedgwick, C. F., and Parrish, C. M.: S. Clin. North America 35:675, 1955.)

The patient is placed on the operating table in either a supine or gall bladder position as described for biliary surgery. The left side of the operating table may be tilted upward. The proposed operative site is cleansed, surrounded by four towels, and the patient draped with a laparotomy sheet (Chapters 3, 4, and 11).

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. Through a long left rectus or oblique subcostal incision the peritoneum is opened.	1. As described for celiotomy opening (Chapter 11)

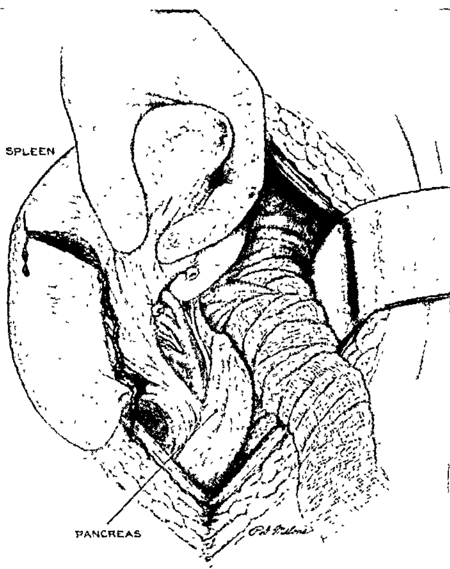


Fig 334.—Emergency splenectomy Exposure of the spleen and ligation of splenic artery (From Sedgwick, C. F S Clin. North America 36:725, 1956)

22. Warren, K. W., and Cattel, R. B: Basic Techniques in Pancreatic Surgery, S. Clin. North America 6:707, 1956.
23. Cattel, R B, and Warren, K. W.: Surgery of the Pancreas, Philadelphia, 1953, W. B. Saunders Co.
24. Martin, J. D, Jr: Wounds of the Liver, Ann. Surg. 125:756, 1947.
25. Lahey, F. H. L.: Technic of Splenectomy, S. Clin. North America 29:738, 1949.
26. Maingot, R.: Splenectomy: Indications and Techniques, Lancet 1:625, 1952.
27. Sedgwick, C. F.: Splenectomy Elective and Emergency, S. Clin. North America 6:725, 1956.
28 Welch, C. S., and Dameshek, W.: "Emergency" Splenectomy, Editorial, Surg. Gynec. & Obst 95:522, 1952.
29 Gross, R E.: Surgery of Infancy and Childhood, Philadelphia, 1953, W. B. Saunders Co, chap. 43.
30. Vaughn, A. M, and Coleman, J. M.: Splenectomy, S. Clin. North America 2:93, 1955.

Steps	*Items*
6. The spleen is dissected from the attachments at the tail of the pancreas. The pedicle is doubly clamped and divided. The spleen is removed.	6. Curved scissors, sponges on holders, cystic duct forceps or long heavy hemostats, specimen basin
7. The vein and artery are doubly ligated. Sometimes they are ligated separately.	7. Chromic gut No. 0 or silk No. 0 or 1, straight scissors
8. The wound is closed.	8. As described for closure of celiotomy (Chapter 11)

REFERENCES

1. Best, C H., and Taylor, N. B.: Physiological Basis of Medical Practice, Baltimore, 1953, Williams & Wilkins Co.
2. Anthony, C. P.: Textbook of Anatomy and Physiology, St. Louis, 1955, The C V. Mosby Co.
3. Blakemore, A.: Diseases of Liver; in Christopher, F.: Textbook of Surgery, ed 6, Philadelphia, 1956, W. B. Saunders Co., chap 21.
4. Himsworth, H. P.: The Liver and Its Diseases, Lowell Lectures, Cambridge, Mass, 1947, Harvard University Press.
5. Lichtman, S. S.: Diseases of the Liver, Gallbladder, and Bile Ducts, ed. 3, Philadelphia, 1953, Lea & Febiger.
6. Rienhoff, W F., Jr, and Pickrell, K. L.: Pancreatitis: Anatomic Study of the Pancreatic and Extrahepatic Biliary Systems, Arch. Surg. 51:205, 1945.
7. Martin, G. J.: Ion Exchange and Adsorption of Agents in Medicine, Boston, 1955, Little, Brown & Co.
8. Puestow, C. B · Surgery of the Biliary Tract, Chicago, 1953, Year Book Publishers, Inc
9. Moseley, H. F.: Textbook of Surgery, ed. 2., St. Louis, 1955, The C. V. Mosby Co.
10. Partipilo, A.: Surgical Techniques and Principles of Operative Surgery, ed. 5, Philadelphia, 1953, Lea & Febiger.
11. Positioning the Patient for Surgery, 1957, A.N.A.-N L.N. Film Library, New York; Surgical Film Library, American Cyanamid Co., Danbury, Conn.
12. Cole, W. B: Operative Technic, New York, 1949, Appleton-Century-Crofts, Inc.
13. Horsley, G. W., and Bigger, I. A: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co., chaps. 62, 63.
14. Shackelford, R. T, and Dugan, H J: Bickham-Callander: Surgery of the Alimentary Tract, Philadelphia, 1955, W B Saunders Co., vol. I, chaps 3, 4; vol. II, chaps. 5, 6; vol. III, chap. 13
15. Carter, R. F, and Gillette, L.: Immediate Operative Cholangiography, J.A.M.A. 143:951, 1950
16. Glenn, F: Liver and Biliary System; in Christopher, F: Textbook of Surgery, ed. 6, Philadelphia, 1956, W B Saunders Co, chap. 21
17. Slattery, L. R., and Saypal, G M · Intraabdominal Choledochography, Am. J. Surg. 84:229, 1952
18. Warren, K. W: Technique of Cholecystectomy and Choledochostomy, S. Clin. North America 6.687, 1956
19. Wilder, J. R.: Atlas of General Surgery, St Louis, 1956, The C. V. Mosby Co
20. Diffenbaugh, W G., and Strohl, L E: Common Bile Duct—Exploration for Stones, S. Clin. North America 2:119, 1955.
21. Welch, C. E.: Choledochotomy, Surg Gynec & Obst. 102:495, 1956.

22. Warren, K. W., and Cattel, R. B.: Basic Techniques in Pancreatic Surgery, S. Clin. North America 6:707, 1956.
23. Cattel, R. B., and Warren, K. W.: Surgery of the Pancreas, Philadelphia, 1953, W. B. Saunders Co.
24. Martin, J. D., Jr: Wounds of the Liver, Ann. Surg. 125:756, 1947.
25. Lahey, F. H. L.: Technic of Splenectomy, S Clin. North America 29:738, 1949.
26. Maingot, R.: Splenectomy: Indications and Techniques, Lancet 1:625, 1952.
27. Sedgwick, C. F., Splenectomy. Elective and Emergency, S. Clin. North America 6:725, 1956.
28. Welch, C. S., and Dameshek, W.: "Emergency" Splenectomy, Editorial, Surg. Gynec. & Obst. 95:522, 1952.
29. Gross, R. E.: Surgery of Infancy and Childhood, Philadelphia, 1953, W. B. Saunders Co, chap. 43.
30. Vaughn, A. M., and Coleman, J. M.: Splenectomy, S. Clin. North America 2:93, 1955.

CHAPTER 14

OPERATIONS ON THE LARGE INTESTINE, COLON, RECTUM, AND ANUS

REGIONAL ANATOMY

The large intestine begins in the lower right abdominal cavity, with the cecum, which is attached to the ileum and extends about two and one-half inches below it (Fig. 336). The adult cecum is usually adherent to the posterior wall of the peritoneal cavity and has a serosal covering on its anterior wall only (Fig. 337). The cecum forms a blind pouch from which projects the appendix. The taenia coli which is attached to the cecum anteriorly, terminates at the appendix.[1-5]

The colon, which comprises the remaining portion of the large intestine, is divided into four parts: ascending, transverse, descending, and sigmoid. These portions form an inverted U within the abdominal cavity (Fig. 337). Although the mesocolon provides some stability for the colon, there is a great variation in its mobility. The ascending portion of the large intestine, which is about 6 inches long, extends from the level of the ileocecal valve upward to the hepatic flexure. Since generally it is not entirely covered by peritoneum, it is rather fixed. The upper portion of the ascending colon lies behind the right lobe of the liver and in front of the anterior surface of the right kidney.

The transverse colon, about 20 inches long and beginning at the hepatic flexure, lies transversely across the abdominal cavity and ends at the splenic flexure near the spleen (Fig. 320). It lies below the stomach and has a mesentery, which is called the transverse mesocolon.

The descending colon, which is about 7 inches long, extends from the left colic flexure to the region below the iliac crest. It is firmly attached to the posterior abdominal wall. The iliac portion of the sigmoid colon, which is about 6 inches long, lies on the inner surface of the left iliacus muscle. The remaining portion of the colon passes over the pelvic brim into the pelvic cavity, lying partly in the abdomen and the pelvis. It forms an S curve in the pelvis, terminating in the rectum at a level with the third segment of the sacral vertebras.

The structural wall of the colon is similar to that of the small intestine (Chapter 12) except for the presence of taeniae coli, appendices epiploicae, and haustra.

The superior mesenteric artery supplies the appendix, the cecum, and the proximal portion of the colon; the inferior mesenteric artery supplies the remainder of the colon (Fig. 338).

The rectum, which continues above with the sigmoid colon, leaves the peritoneal cavity in the pelvis at the rectosigmoid junction and terminates in the anus. The rectum, a slightly curved passage about 6 inches long, is surrounded by pelvic fascia as it lies on the anterior surface of the sacrum and coccyx (Fig. 339). In the male, the rectum lies behind the prostate gland and the bladder (Chapter 16). In the female, the rectum lies behind the uterus and the vagina (Chapter 15). The rectum dilates just before it becomes the anal canal, and this dilation or ampulla presents folds called Houston's valves. The wall of the rectum consists of four layers similar to those of the small intestine (Chapter 12).[6-8]

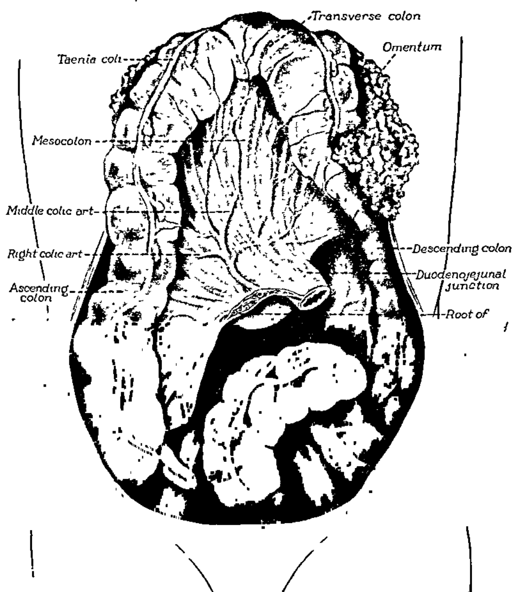


Fig 336—Colon and root of mesentery. The transverse colon has been turned upward to show the duodenojejunal junction. (From Francis, C. C: Introduction to Human Anatomy, St. Louis, 1954, The C. V. Mosby Co)

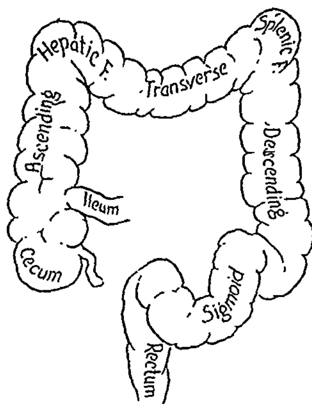
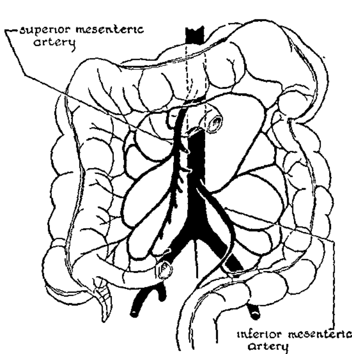
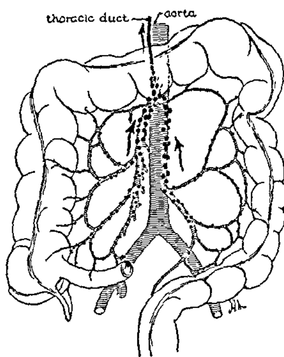


Fig. 337 —Anatomic divisions of large intestine (colon), showing the placement of ileocecal valve, the hepatic flexure, and the splenic flexure.





A *B.*

Fig. 338 —*A*, Normal arterial supply of the colon. *B*, The lymphatic drainage of the colon (From Moseley, F. H: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co.)

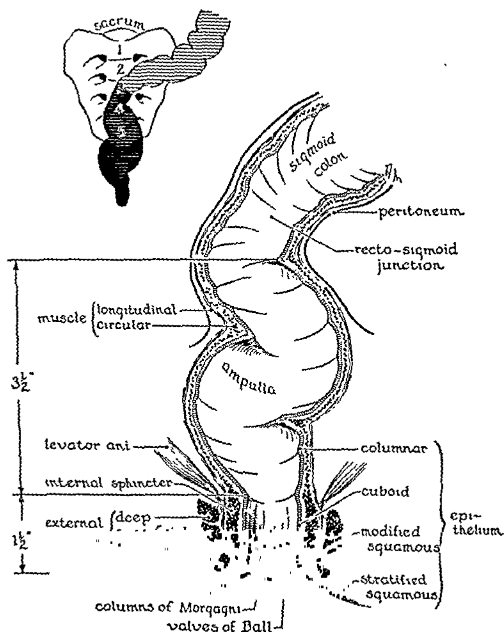


Fig 399.—Diagrammatic anatomy of the rectum. (From Moseley, F. H: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co)

The anal canal is a narrow passage about 1 inch long, which passes downward and backward. It is surrounded and controlled by two circular bands, which form the external and internal anal sphincters (Fig. 340). The act of defecation is accomplished by contraction of the rectal and abdominal muscles, the descent of the diaphragm, and the relaxation of the sphincter muscles.[6, 7, 9 12]

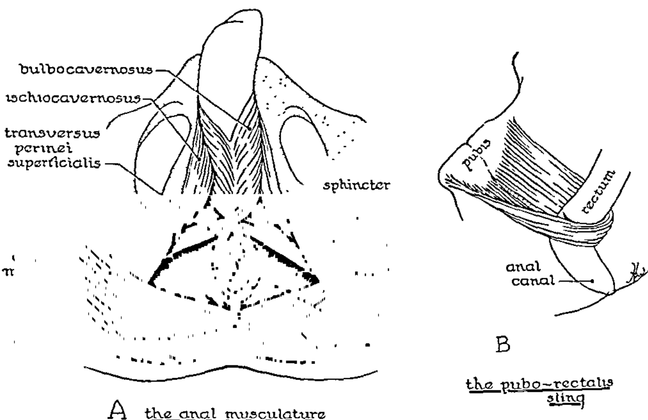


Fig 340.—Anal musculature (From Moseley, F. H.: Textbook of Surgery, St Louis, 1955, The C. V. Mosby Co)

STERILE ITEMS FOR SPECIFIC OPERATIONS

Appendectomy.—Major celiotomy setup (Chapter 11), plus Babcock forceps and gastrointestinal sutures, carbolic acid and alcohol (Chapter 12). Instruments and draping sheets (Chapter 4) and instruments (Chapters 11 and 12) must be suitable to the patient.

Abdominoperineal Resection.—

1. *Abdominal Stage*—Basic gastrointestinal setup (Chapter 12), including the following:

1 Deep blade for self-retaining retractor
1 Deaver retractor, wide blade
1 Furniss-Clute clamp with needle and suture
2 Payr clamps, 8 inches, or Martel clamps
2 Allen or Ochsner clamps, 10 inches
4 Rochester-Carmalt hemostats, curved, 9 inches
4 Thomas-Allis forceps, 6 and 7 teeth, 8 inches
1 Senn bullet forceps, 9 inches
1 Mayo-Harrington scissors, 10 inches

2 Kelly tissue forceps, 9 inches
1 Piece rubber dam, 10 by 10 inches
2 *Sutures, silk No. 5, 18 inches*
1 Glass rod, desired type, and rubber tubing
1 Pezzer catheter, No. 20 or 18 F
1 Foley catheter, No. 16 or 12 F
½ Yard cotton tape, 12 inches
½ Yard petrolatum gauze, if desired
1 Yard iodoform gauze packing
Cautery set

2. *Perineal Stage.*—

1 Deaver retractor, 1 by 12 inches
2 Murphy retractors, if desired
2 Israel or Ollier retractors
2 Babcock or Harrington bladder retractors
2 Kelly tissue forceps, 2 and 3 teeth, 7 inches
2 Tissue forceps, without teeth—1, 10; 1, 12 inches
2 Russian tissue forceps, 9 inches, if desired
2 Senn forceps, if desired
2 Mayo or Mayo-Noble scissors—1 curved; 1 straight, 6¾ inches
1 Ferguson or Reinhoff scissors, angular jaws, curved to right and left, 9 inches, optional
4 Allis forceps, 5 and 6 teeth, 7 inches
2 Hegar needle holders, heavy type, 7 inches
12 Mayo-Pean hemostats, curved, 8 inches
4 Rochester-Carmalt hemostats, curved, 8 inches
Electrocoagulation unit and electrodes, optional
Rectal catheter
4 Ochsner hemostats
1 Rongeur
1 Periosteal elevator
1 Bone-cutting forceps
1 Kirschman or Kelly anoscope
1 Suction set, optional
1 Asepto syringe, 2 ounces
1 Irrigating can, tubing, and catheter, optional
2 Yards gauze packing, plain and disinfectant (Zephiran chloride 1:5,000)
2 Yards iodoform packing, if desired
1 Piece rubber dam 18 by 12 inches, optional

Textiles

Perineal pack (Chapter 15)
Lithotomy or
Laparotomy sheet
Basin set
Gown pack
Glove set

Sutures

Chromic gut Nos. 1, 0, and 2-0
Silk Nos. 3-0, 2-0, and 0
4 Mayo needles ½-circle—2, taper-point No. 3 or 4; 2 trocar-point No. 3.
2 Surgeon's regular needles, ⅜-circle cutting-edge No. 4
2 Intestinal sutures, chromic gut No. 2-0 or 0 swaged-on needle

3. *Perineal Resection With Preservation of the Sphincter.*—Perineal setup, plus 2 Payr or Allen clamps. The colostomy is not performed during the first-stage operation.

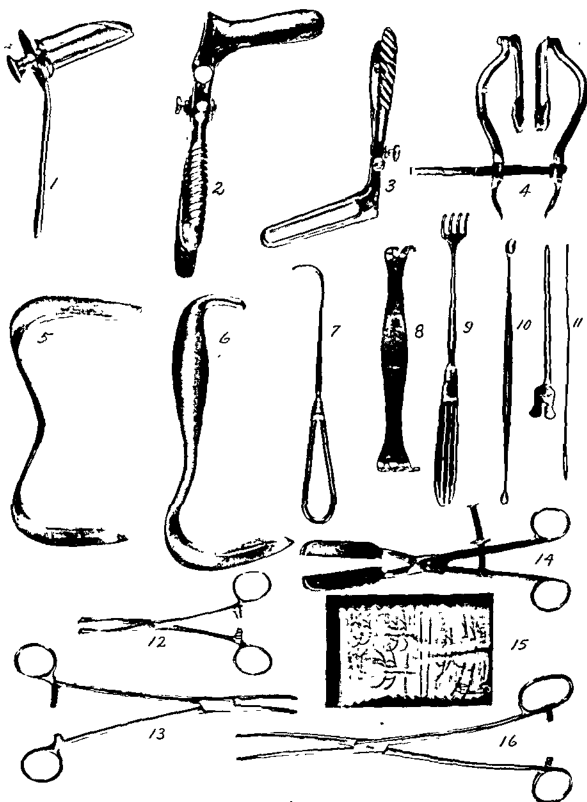
Cecostomy.—Basic gastrointestinal setup (Chapter 12), plus the following:

1 Freyer drain, or Malecot catheter No. 16 or 18 F
1 Local anesthetic set and drug desired

Colectomy (Right) and Ileocolostomy.—

First Stage.—

Basic gastrointestinal setup (Chapter 12)
2 Payr clamps, 8 or 11 inches



1, Newman anoscope, *2*, Pratt bivalve speculum;
etaining anal retractor; *5*, Sims speculum; *6*, Sims
yo-Collins retractor; *9*, Volkman sharp or dull re-
obe, *12*, Pennington forceps; *13*, Buie pile clamp;
uterine dressing forceps

Second Stage.—
Minor dissecting setup (Chapter 11)
Pemberton or Best right-angled clamps, or
Wangensteen, Mikulicz, or Stetton crushing spur clamps
Chromic gut No. 2-0 swaged-on needles
Silk No. 4-0 for skin
2 Mayo-Pean hemostats, straight, 8 inches
2 Ochsner hemostats, 8 inches
2 Mayo-Collins or small Deaver retractors
Dressings, desired type
Petrolatum gauze
Iodoform gauze packing, 1 inch, optional

Third Stage.—As listed for closure of colostomy

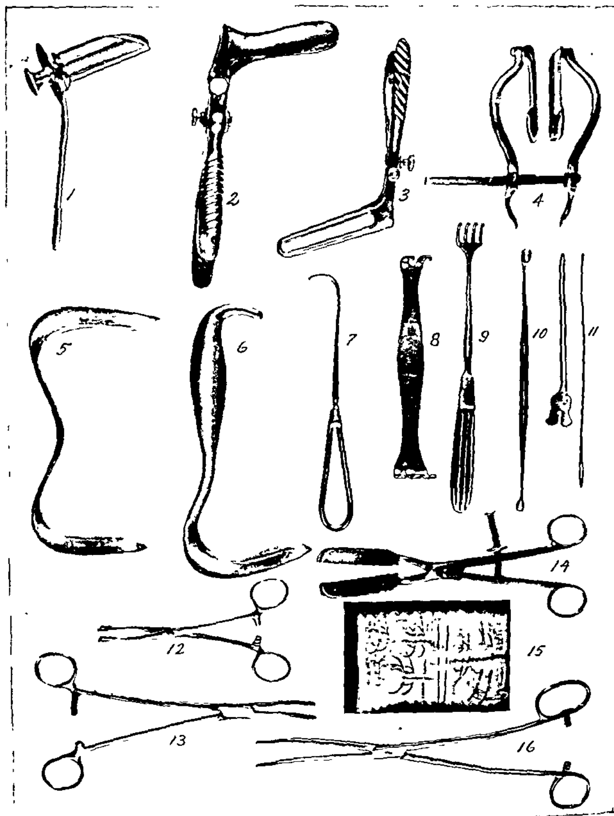
Colostomy Closure.—Basic gastrointestinal setup (Chapter 12), plus the following:
1 Rankin clamp
2 Payr clamps, small, or
4 Ochsner clamps
1 Furniss-Clute clamp
1 Penrose drain

Colostomy (Loop or Transverse Type).—Basic gastrointestinal setup (Chapter 12), plus the following:
1 Deaver retractor, medium width
4 Ochsner clamps, straight, 8 inches
1 Trocar and cannula
2 Glass rods and tubing
1 Dakin tube, 18 inches
2 Mayo-Pean hemostats, curved, 8 inches
2 Payr clamps, 8 or 12 inches
2 Robinson 4-eyed catheters, Nos. 24 and 30 F
Rubber tube drain, large lumen
Petrolatum gauze
Cautery set

Hemorrhoidectomy (Excision or Ligation).—
1 Sigmoidoscopy setup
1 Irrigating setup, if desired
1 Anoscope
1 Rectal speculum, bivalve or fenestrated blades
1 Anoretractor, swivel blade
1 Mayo-Collins or Deaver retractor, narrow blade
6 Sponge-holding forceps
4 Towel forceps
6 Allis forceps
4 Pennington forceps, triangular jaws, 5¾ inchs
1 Hemorrhoid clamp or Mayo-Carmalt hemostat
2 Mayo-Pean or Crile hemostats
2 Kelly hemostats, curved
2 Tissue forceps without teeth—1, 5½; 1, 7 inches
2 Tissue forceps with 1 and 2 teeth—1, 5½; 1, 7 inches
2 Mayo scissors, 1 curved, 1 straight
1 Suture scissors
2 Scalpel handles Nos. 3 and 4 and blades Nos. 10 or 20
1 Probe and director
2 Needle holders
1 Urethral catheter No. 14 or 16 F
1 Rectal tube, if desired
1 Piece of soft rubber tubing, desired size
Petrolatum gauze packing
Perineal operating pack
Fenestrated sheet, laparotomy or lithotomy type
Glove set
Gown set
Basin set

Sutures

Chromic gut Nos. 0, 2-0, and 3-0
Silk No. 3-0
2 Murphy or Ferguson needles, ½-circle taper-point
2 Surgeon's regular needles, ⅜-circle cutting-edge
(Swaged-on needles should be used)



-rations 1, Newman anoscope; 2, Pratt bivalve speculum; h self-retaining anal retractor; 5, Sims speculum; 6, Sims 8, Mayo Collins retractor; 9, Volkman sharp or dull re- and probe, 12, Pennington forceps; 13, Buie pile clamp; ›zeman uterine dressing forceps

Incision of Thrombosed Hemorrhoids.—

1 Anoscope
1 Rectal speculum
1 Tissue forceps without teeth, 5½ inches
1 Mayo scissors, curved
1 Metzenbaum scissors
1 Probe and grooved director
1 Curette
2 Small retractors, right-angled
1 Scalpel handle No. 3 and blades Nos. 10 and 11
2 Mayo-Kelly hemostats
2 Crile hemostats
2 Allis-Adair forceps
3 Sponge-holding forceps
1 Needle holder
1 Chromic gut suture No. 3-0 swaged-on needle
Petrolatum gauze packing
Lubricating jelly
Local anesthetic set, if desired
Perineal pack
Gown set
Glove set
Basin set

Injection Set for Internal Hemorrhoids.—

3 Syringes—2, 2 ml.; 1, 10 ml.
2 Aspirating needles—1, gauge 20, 3 inches; 1, gauge 21, 1½ inches
Drug, desired type

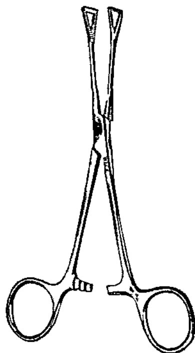


Fig 345.

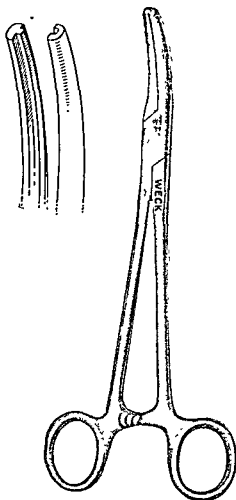


Fig 346

Fig 345—Pennington forceps, straight, triangular jaws.
Fig 346—Buie pile clamp.

(Courtesy Edward Weck & Co, Inc, Brooklyn, N. Y.)

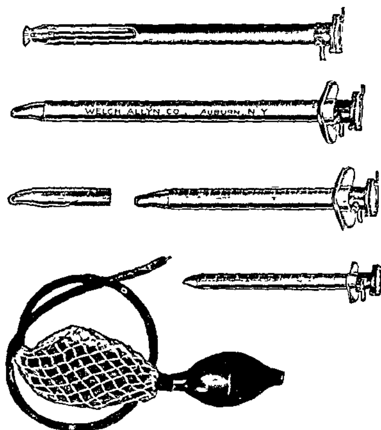


Fig 342—Welch Allyn-Montague proctoscopes, 6 inches, 10 inches, and sigmoidoscopes with dilating bulb

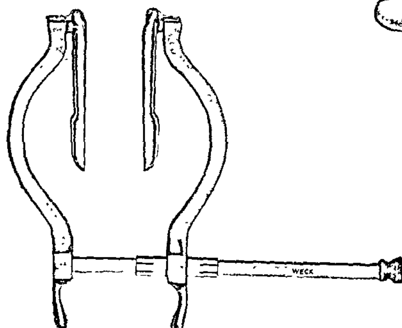


Fig 343 Fig 344.

Fig 343—Buie-Smith rectal speculum
Fig 344—Sims rectal speculum

(Courtesy Edward Weck & Co, Inc, Brooklyn, N Y.)

Incision of Thrombosed Hemorrhoids.—

1 Anoscope
1 Rectal speculum
1 Tissue forceps without teeth, 5½ inches
1 Mayo scissors, curved
1 Metzenbaum scissors
1 Probe and grooved director
1 Curette
2 Small retractors, right-angled
1 Scalpel handle No. 3 and blades Nos. 10 and 11
2 Mayo-Kelly hemostats
2 Crile hemostats
2 Allis-Adair forceps
3 Sponge-holding forceps
1 Needle holder
1 Chromic gut suture No. 3-0 swaged-on needle
Petrolatum gauze packing
Lubricating jelly
Local anesthetic set, if desired
Perineal pack
Gown set
Glove set
Basin set

Injection Set for Internal Hemorrhoids.—

3 Syringes—2, 2 ml.; 1, 10 ml.
2 Aspirating needles—1, gauge 20, 3 inches; 1, gauge 21, 1½ inches
Drug, desired type

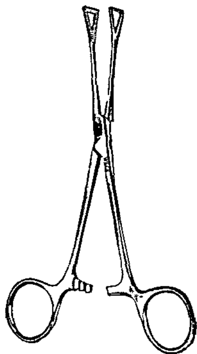


Fig 345.

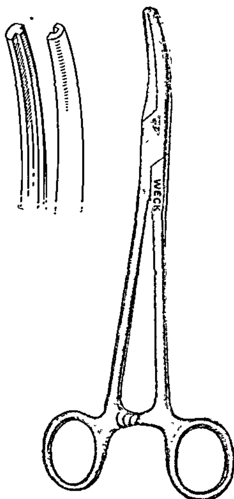


Fig 346.

Fig. 345.—Pennington forceps, straight, triangular jaws
Fig 346.—Buie pile clamp

(Courtesy Edward Weck & Co, Inc, Brooklyn, N. Y.)

Ileostomy.—Basic gastrointestinal setup (Chapter 12), plus the following:

2 Payr clamps, 8 inches
2 Allen or Furniss-Clute clamps
Cautery set
1 Urethral catheter, Pezzer or Malecot, Nos. 20 or 22 F

Incision of Ischiorectal Abscess.—

1 Anoscope
1 Rectal speculum
1 Scalpel handle No. 4, blade No. 20
1 Tissue forceps with 1 and 2 teeth
1 Tissue forceps without teeth
1 Mayo scissors
2 Kelly hemostats, curved
2 Mayo-Pean hemostats, curved
2 Allis forceps
2 Sponge-holding forceps
1 Probe and director
1 Needle holder
1 Intestinal suture, chromic gut No. 3-0, ½-circle needle
1 Urethral catheter No. 16 F
1 Rubber drain, if desired
Petrolatum gauze or iodoform packing
1 Perineal pack and draping sheet
1 Basin set, minor
1 Gown pack
Glove set
1 Local anesthetic setup

Polypectomy of Sigmoid Colon.—Setup as listed for first-stage abdominoperineal resection.

Polypectomy of Rectosigmoid or Rectum.—Setup as listed for second-stage perineal abdominoperineal resection.

Rectosigmoid Resection.—As listed for abdominal stage of abdominoperineal resection.

POSITION, SKIN PREPARATION, AND DRAPING PROCEDURE

The patient is placed on the operating table in a supine position for an abdominal operation. When the lesion involves the lower sigmoid colon, the patient is positioned on the operating table in a slight Trendelenburg position (Chapters 4 and 15). Routine skin cleansing is done (Chapter 3). The patient is draped with a fenestrated sheet (Chapters 4 and 15). Preventive measures described for gastrointestinal operations are carried out (Chapter 12).

OPERATIONS

Ileostomy

Definition.—Formation of a temporary or permanent opening into the ileum.

Considerations.—An ileostomy generally is done when an extensive lesion is present and a resection of a large portion or all the colon is contemplated.[12, 13]

Purpose.—To provide for complete rest of the colon by means of diversion.

Setup, Position, Skin Preparation, and Draping Procedure.—The setup as listed previously in this chapter. The patient is placed on the operating table in a supine position (Chapter 4).

Operative Procedure.—

Steps	*Items*
1. Through an abdominal incision the peritoneal cavity is explored and the ileum mobilized. Preventive measures described for gastrointestinal surgery are carried out.	1. As described for opening in celiotomy (Chapter 11); Allis and Babcock forceps, laparotomy pads (Chapter 12)
2. The ileum is grasped with intestinal forceps and divided at the proposed site for the ileostomy.	2. Babcock, Allen, or Doyen clamps, scalpel or cautery (Chapter 12)
3. The distal end of the ileum is closed or is brought up to the abdominal wall. The proximal end is brought out to the skin so that the stoma is long enough to deliver its contents into an ileostomy bag. The clamps are removed, and a catheter is introduced into the stoma and held in place with sutures. The wound is closed around the stoma and dressings applied.	3. Intestinal sutures as described for closed anastomosis (Chapter 12); scalpel, Crile hemostats, Allis-Adair and Babcock forceps, laparotomy pads, ligatures for subcutaneous bleeders, urethral catheter No. 16 F, silk sutures No. 3-0, needle holder, scissors; sutures as for closure of celiotomy (Chapter 11), desired dressings

Cecostomy

Definition.—Through a McBurney or a low right rectus muscle-splitting incision, an artificial opening is made into the cecum (Chapter 11), and a tube is inserted into it for drainage of the bowel.

Purposes.—To relieve a complete obstruction involving the colon situated distal to the cecum, to treat an advanced obstruction due to the presence of a carcinoma in the left colon, or to prevent postoperative distention.[6, 8, 9, 16]

Setup, Position, Skin Preparation, and Draping Procedure.—As described previously in Chapter 12. The patient is placed on the operating table in a supine position (Chapter 4). The proposed operative site is disinfected, and the patient is draped with sterile towels and a fenestrated laparotomy sheet (Chapters 4 and 11) as described for a celiotomy.

Operative Procedure.—

Steps	*Items*
1. The abdomen is opened and retracted. The peritoneal cavity is explored and protected (Fig. 347).	1. As described for opening of a celiotomy (Chapter 11)
2 The cecum, if distended, is deflated.	2. Laparotomy pads, trocar and cannula, suction set, basin, Allis-Adair forceps, sponges on holders
3 A portion of the cecum is mobilized. A purse-string suture is placed around proposed site for the opening.	3. Allis-Adair and Babcock forceps, chromic gut No. 2-0 or silk No. 3-0, swaged-on intestinal ½-circle needle, needle holder, tissue forceps, scissors

Ileostomy.—Basic gastrointestinal setup (Chapter 12), plus the following:

2 Payr clamps, 8 inches
2 Allen or Furniss-Clute clamps
Cautery set
1 Urethral catheter, Pezzer or Malecot, Nos. 20 or 22 F

Incision of Ischiorectal Abscess.—

1 Anoscope
1 Rectal speculum
1 Scalpel handle No. 4, blade No. 20
1 Tissue forceps with 1 and 2 teeth
1 Tissue forceps without teeth
1 Mayo scissors
2 Kelly hemostats, curved
2 Mayo-Pean hemostats, curved
2 Allis forceps
2 Sponge-holding forceps
1 Probe and director
1 Needle holder
1 Intestinal suture, chromic gut No. 3-0, ½-circle needle
1 Urethral catheter No. 16 F
1 Rubber drain, if desired
Petrolatum gauze or iodoform packing
1 Perineal pack and draping sheet
1 Basin set, minor
1 Gown pack
Glove set
1 Local anesthetic setup

Polypectomy of Sigmoid Colon.—Setup as listed for first-stage abdominoperineal resection.

Polypectomy of Rectosigmoid or Rectum.—Setup as listed for second-stage perineal abdominoperineal resection.

Rectosigmoid Resection.—As listed for abdominal stage of abdominoperineal resection.

POSITION, SKIN PREPARATION, AND DRAPING PROCEDURE

The patient is placed on the operating table in a supine position for an abdominal operation. When the lesion involves the lower sigmoid colon, the patient is positioned on the operating table in a slight Trendelenburg position (Chapters 4 and 15). Routine skin cleansing is done (Chapter 3). The patient is draped with a fenestrated sheet (Chapters 4 and 15). Preventive measures described for gastrointestinal operations are carried out (Chapter 12).

OPERATIONS

Ileostomy

Definition.—Formation of a temporary or permanent opening into the ileum.

Considerations.—An ileostomy generally is done when an extensive lesion is present and a resection of a large portion or all the colon is contemplated.[12-13]

Purpose.—To provide for complete rest of the colon by means of diversion.

Setup, Position, Skin Preparation, and Draping Procedure.—The setup as listed previously in this chapter. The patient is placed on the operating table in a supine position (Chapter 4).

Operative Procedure.—

Steps	*Items*
1. Through an abdominal incision the peritoneal cavity is explored and the ileum mobilized. Preventive measures described for gastrointestinal surgery are carried out.	1. As described for opening in celiotomy (Chapter 11); Allis and Babcock forceps, laparotomy pads (Chapter 12)
2. The ileum is grasped with intestinal forceps and divided at the proposed site for the ileostomy.	2. Babcock, Allen, or Doyen clamps, scalpel or cautery (Chapter 12)
3. The distal end of the ileum is closed or is brought up to the abdominal wall. The proximal end is brought out to the skin so that the stoma is long enough to deliver its contents into an ileostomy bag. The clamps are removed, and a catheter is introduced into the stoma and held in place with sutures. The wound is closed around the stoma and dressings applied.	3. Intestinal sutures as described for closed anastomosis (Chapter 12); scalpel, Crile hemostats, Allis-Adair and Babcock forceps, laparotomy pads, ligatures for subcutaneous bleeders, urethral catheter No. 16 F, silk sutures No. 3-0, needle holder, scissors; sutures as for closure of celiotomy (Chapter 11), desired dressings

Cecostomy

Definition.—Through a McBurney or a low right rectus muscle-splitting incision, an artificial opening is made into the cecum (Chapter 11), and a tube is inserted into it for drainage of the bowel.

Purposes.—To relieve a complete obstruction involving the colon situated distal to the cecum, to treat an advanced obstruction due to the presence of a carcinoma in the left colon, or to prevent postoperative distention.[6, 8, 9, 16]

Setup, Position, Skin Preparation, and Draping Procedure.—As described previously in Chapter 12. The patient is placed on the operating table in a supine position (Chapter 4). The proposed operative site is disinfected, and the patient is draped with sterile towels and a fenestrated laparotomy sheet (Chapters 4 and 11) as described for a celiotomy.

Operative Procedure.—

Steps	*Items*
1 The abdomen is opened and retracted The peritoneal cavity is explored and protected (Fig. 347).	1. As described for opening of a celiotomy (Chapter 11)
2. The cecum, if distended, is deflated.	2. Laparotomy pads, trocar and cannula, suction set, basin, Allis-Adair forceps, sponges on holders
3. A portion of the cecum is mobilized. A purse-string suture is placed around proposed site for the opening.	3. Allis-Adair and Babcock forceps, chromic gut No. 2-0 or silk No. 3-0, swaged-on intestinal ½-circle needle, needle holder, tissue forceps, scissors

Ileostomy.—Basic gastrointestinal setup (Chapter 12), plus the following:

2 Payr clamps, 8 inches
2 Allen or Furniss-Clute clamps
Cautery set
1 Urethral catheter, Pezzer or Malecot, Nos. 20 or 22 F

Incision of Ischiorectal Abscess.—

1 Anoscope
1 Rectal speculum
1 Scalpel handle No. 4, blade No. 20
1 Tissue forceps with 1 and 2 teeth
1 Tissue forceps without teeth
1 Mayo scissors
2 Kelly hemostats, curved
2 Mayo-Pean hemostats, curved
2 Allis forceps
2 Sponge-holding forceps
1 Probe and director
1 Needle holder
1 Intestinal suture, chromic gut No. 3-0, ½-circle needle
1 Urethral catheter No. 16 F
1 Rubber drain, if desired
Petrolatum gauze or iodoform packing
1 Perineal pack and draping sheet
1 Basin set, minor
1 Gown pack
Glove set
1 Local anesthetic setup

Polypectomy of Sigmoid Colon.—Setup as listed for first-stage abdominoperineal resection.

Polypectomy of Rectosigmoid or Rectum.—Setup as listed for second-stage perineal abdominoperineal resection.

Rectosigmoid Resection.—As listed for abdominal stage of abdominoperineal resection.

POSITION, SKIN PREPARATION, AND DRAPING PROCEDURE

The patient is placed on the operating table in a supine position for an abdominal operation. When the lesion involves the lower sigmoid colon, the patient is positioned on the operating table in a slight Trendelenburg position (Chapters 4 and 15). Routine skin cleansing is done (Chapter 3). The patient is draped with a fenestrated sheet (Chapters 4 and 15). Preventive measures described for gastrointestinal operations are carried out (Chapter 12).

OPERATIONS

Ileostomy

Definition.—Formation of a temporary or permanent opening into the ileum.

Considerations.—An ileostomy generally is done when an extensive lesion is present and a resection of a large portion or all the colon is contemplated.[12-15]

Purpose.—To provide for complete rest of the colon by means of diversion.

Setup, Position, Skin Preparation, and Draping Procedure.—The setup as listed previously in this chapter. The patient is placed on the operating table in a supine position (Chapter 4).

Operative Procedure.—

Steps	*Items*
1. Through an abdominal incision the peritoneal cavity is explored and the ileum mobilized. Preventive measures described for gastrointestinal surgery are carried out.	1. As described for opening in celiotomy (Chapter 11); Allis and Babcock forceps, laparotomy pads (Chapter 12)
2. The ileum is grasped with intestinal forceps and divided at the proposed site for the ileostomy.	2. Babcock, Allen, or Doyen clamps, scalpel or cautery (Chapter 12)
3. The distal end of the ileum is closed or is brought up to the abdominal wall. The proximal end is brought out to the skin so that the stoma is long enough to deliver its contents into an ileostomy bag. The clamps are removed, and a catheter is introduced into the stoma and held in place with sutures. The wound is closed around the stoma and dressings applied.	3. Intestinal sutures as described for closed anastomosis (Chapter 12); scalpel, Crile hemostats, Allis-Adair and Babcock forceps, laparotomy pads, ligatures for subcutaneous bleeders, urethral catheter No. 16 F, silk sutures No. 3-0, needle holder, scissors; sutures as for closure of celiotomy (Chapter 11), desired dressings

Cecostomy

Definition.—Through a McBurney or a low right rectus muscle-splitting incision, an artificial opening is made into the cecum (Chapter 11), and a tube is inserted into it for drainage of the bowel.

Purposes.—To relieve a complete obstruction involving the colon situated distal to the cecum, to treat an advanced obstruction due to the presence of a carcinoma in the left colon, or to prevent postoperative distention.[6, 8, 9, 16]

Setup, Position, Skin Preparation, and Draping Procedure.—As described previously in Chapter 12. The patient is placed on the operating table in a supine position (Chapter 4). The proposed operative site is disinfected, and the patient is draped with sterile towels and a fenestrated laparotomy sheet (Chapters 4 and 11) as described for a celiotomy.

Operative Procedure.—

Steps	*Items*
1 The abdomen is opened and retracted. The peritoneal cavity is explored and protected (Fig. 347).	1. As described for opening of a celiotomy (Chapter 11)
2. The cecum, if distended, is deflated.	2. Laparotomy pads, trocar and cannula, suction set, basin, Allis-Adair forceps, sponges on holders
3. A portion of the cecum is mobilized. A purse-string suture is placed around proposed site for the opening.	3. Allis-Adair and Babcock forceps, chromic gut No. 2-0 or silk No 3-0, swaged-on intestinal ½ circle needle, needle holder, tissue for[illegible]

Steps	*Items*
4. Stab wound is made within the area of the purse-string suture, a tube inserted, and the suture *tightened around it.*	4. Scalpel, suction set, Pezzer or Malecot catheter No. 16 or 18 F, scissors
5. The cecum is sutured to the peritoneum, or a portion of the cecum may be brought out of the wound and sutured to the subcutaneous tissue and skin. The abdominal wound is loosely closed around the drain.[2, 17]	5. Chromic gut No. 2-0, intestinal sutures swaged-on needles, items as listed for closure of celiotomy (Chapter 11)

Colostomy (Sigmoidostomy)

Definition.—Through a right rectus incision to expose the transverse colon, or through a left rectus incision to expose the descending sigmoid, a loop of colon is mobilized and the layers of the wound are closed beneath or around it.

Considerations.—Colostomy is done to treat an obstruction in the sigmoid colon due to a malignant lesion, or an advanced inflammation or trauma which has caused a distention of the proximal portion of the colon. A temporary colostomy (a loop or double-barrelled) may be performed prior to a resection of the colon (Fig. 347).

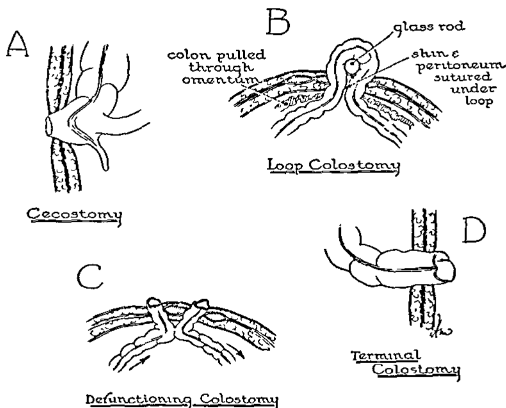


Fig 347.—Types of colostomy (From Moseley, H F.: Textbook of Surgery, St Louis, 1955, The C V Mosby Co)

Purposes.—To decompress the bowel and to give rest to the colon. The Mikulicz temporary colostomy is designed to re-establish bowel continuity without entering the abdominal cavity.[6, 8, 9, 17-19]

Setup, Position, Skin Preparation, and Draping Procedure.—As described previously for surgery on the small and large bowel. Preventive measures described in Chapters 11 and 12 are carried out.

Operative Procedure (Loop Colostomy).—

Steps for First Stage	*Items*
1. The abdomen is opened; the wound edges are protected and retracted. Then the peritoneal cavity is opened and walled off with packs.	1. Roux or Richardson retractors, moist laparotomy pads, tissue forceps, ligatures, scissors; as described for opening a celiotomy (Chapter 11)
2. A small opening is made in the mesentery near the bowel wall; a rubber tube is passed through it for traction of the colon	2. Long curved scissors, piece of soft rubber tubing, Mayo-Pean curved hemostat, Crile hemostat, straight, chromic gut No. 3-0 or 2-0 or silk 3-0 for ligature
3. A loop of colon is brought through the abdominal incision.	3. Allis-Judd and Babcock forceps, moist pads
4. The peritoneum is closed beneath the loop of colon; the fascia and skin may be sutured beneath the loop.	4. Chromic gut No. 2-0, swaged-on ½-circle taper-point needles, needle holder, tissue forceps, silk No. 3-0, glass rod, and piece of rubber tubing
5. A glass rod is attached to one end of the rubber tube which is situated under the loop, and then the rubber tube is withdrawn, leaving the rod under the loop In some clinics the tubing is not replaced by the rod. The glass rod or tubing stabilizes the loop of colon.	
6 A catheter may be placed in the proximal portion of the loop and fixed by sutures for immediate decompression. Protruding bowel and wound are dressed.	6. Pezzer or Malecot catheter, chromic gut sutures No. 0 or 2-0, needle holders, tissue forceps, scissors, petrolatum gauze, dressing set

Steps for Second-Stage Loop Colostomy.—After 48 hours the loop of colon is completely severed with a cautery. By this time, if there is no tension, healing has advanced sufficiently to make it safe to allow feces onto the wound.

Closure of Colostomy

Definition.—Closure of the walls of the colon and repair of the [illegible] wall. When the loop has been completely divided, a septic or an aseptic anastomosis is performed.

Consideration.—A colostomy is closed in certain conditions, if feasible.

Purpose.—To re-establish intestinal continuity.[2, 18, 33]

Setup, Position, Skin Preparation, and Draping Procedure.—As described previously for surgery on the large bowel. Preventive measures described for anastomosis are carried out (Chapter 12).

Steps	*Items*
4. Stab wound is made within the area of the purse-string suture, a tube inserted, and the suture tightened around it	4. Scalpel, suction set, Pezzer or Malecot catheter No. 16 or 18 F, scissors
5. The cecum is sutured to the peritoneum, or a portion of the cecum may be brought out of the wound and sutured to the subcutaneous tissue and skin. The abdominal wound is loosely closed around the drain.[2, 17]	5. Chromic gut No. 2-0, intestinal sutures swaged-on needles, items as listed for closure of celiotomy (Chapter 11)

Colostomy (Sigmoidostomy)

Definition.—*Through a right rectus incision to expose the transverse colon, or through a left rectus incision to expose the descending sigmoid, a loop of colon is mobilized and the layers of the wound are closed beneath or around it.*

Considerations.—Colostomy is done to treat an obstruction in the sigmoid colon due to a malignant lesion, or an advanced inflammation or trauma which has caused a distention of the proximal portion of the colon. A temporary colostomy (a loop or double-barrelled) may be performed prior to a resection of the colon (Fig. 347).

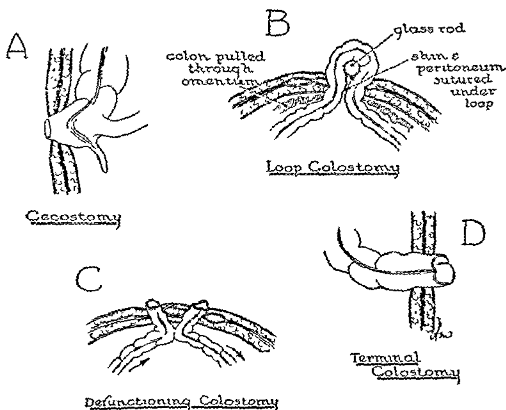


Fig 347—Types of colostomy (From Moseley, H F Textbook of Surgery, St. Louis, 1955, The C V Mosby Co)

Steps	*Items*
3. The cecum is delivered into the wound, the meso-appendix is grasped near tip of the appendix; the peritoneal membrane between appendix and cecal wall along the viscus is divided.	3. Moist pads, Babcock and Allis forceps, Crile or Mayo-Pean hemostats, curved scissors, gauze sponges on holders
4. The appendix is elevated, a hemostat is introduced into the meso-appendix near the cecal wall, and a ligature may be drawn through the open clamp. The meso-appendix is dissected from the appendiceal wall (Fig. 318).	4. Mayo-Pean hemostat, ligature carrier, free ligatures, chromic gut No. 2-0, Crile hemostats, straight
5a. The appendix is crushed at its base with hemostats; the appendix is amputated between clamps with a cautery or scalpel which has been dipped in carbolic acid (Chapter 12). The appendiceal stump is ligated.	5a. 3 Straight hemostats, moist pad, split appendix pad, basin for contaminated items, cautery enclosed in sterile wrapper, or scalpel, 95 per cent carbolic acid, and 70 per cent alcohol on cotton swabs (Chapter 12)
5b. Or appendix is elevated; a purse-string suture is placed in the cecal wall about the base of the appendix. The suture is looped and positioned with forceps and its ends are left long; the appendix is clamped and amputated; the appendiceal stump is inverted into the lumen of the cecum as the purse-string suture is tightened and tied; the suture is cut; the soiled instruments are discarded in the basin. A second row of sutures is placed to approximate the stump of the mesoappendix and the cecum at the site of the inverted appendiceal stump.	5b. Allis forceps, suture chromic gut No. 2-0, swaged-on intestinal straight or curved needle, needle holder, thumb forceps, Babcock forceps, straight hemostats, scissors, 3 hemostats, knife, carbolic acid and alcohol or cautery, plastic thumb forceps, Allis forceps, scissors, basin, sponge, chromic gut No. 3-0, swaged-on curved intestinal needle, needle holder, tissue forceps, sponges, scissors

6 When the appendix cannot be delivered into the wound, the technique is altered to suit the situation. When a gangrenous or ruptured appendix has been removed, the peritoneum is usually drained; in less severe cases a rubber tissue drain is inserted down to the subcutaneous tissue. When the appendix has ruptured and an abscess has formed, drainage is generally accomplished by the insertion of a rubber tube or cigarette (Penrose) drain into the peritoneal cavity. The drain is anchored to the skin; the wound is left unsutured but it is lightly packed with petrolatum gauze packing to prevent pocketing of pus.

7. The abdominal wound is closed as follows: Fascioperitoneal flaps are grasped and sutured; the internal oblique muscles are approximated, the external oblique aponeurosis and anterior rectus fascia are sutured; the skin is closed and the wound dressed.	7. Crile, Hopkins, or Mayo-Pean hemostats, Roux or Parker retractors, tissue forceps, scissors, chromic gut No. 3-0, needle holders, silk, metal clips, or nylon for the skin, dressings (Chapter 11)

Operative Procedure.—

Steps	*Items*
1. The colostomy may be circumcised and the skin margin sutured over the colostomy to avoid contamination of the wound; the layers of the abdominal wall are identified and dissected free.	1. Scalpel, tissue forceps, Crile hemostats, ligatures and scissors, laparotomy pads, and items for opening of celiotomy (Chapter 11)
2. An end-to-end anastomosis is completed by the open (septic) or closed (aseptic) method.	2. As described for gastrojejunostomy (Chapter 12)
3. The abdominal wound is closed; or the skin and the subcutaneous layers are left open and packed. This latter procedure may be done because of the possibilities of contamination. A drain may be inserted, and the wound is closed in layers.	3. Items as listed for closure of celiotomy (Chapter 11), iodoform gauze packing, rubber tube drain

Appendectomy

Definition.—Through a right lower quadrant muscle-splitting incision (McBurney) or a right paramedian or transverse incision, the appendix is severed from its attachment to the cecum and removed from the wound.

Purpose.—To remove a chronic or inflamed appendix, thereby controlling the spread of infection and reducing the danger of peritonitis.[2, 13, 16]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery (Chapter 12). Setup listed previously in this chapter. Skin preparation (Chapter 3) and draping procedure (Chapter 4) are carried out as described for celiotomy (Chapter 11).

Operative Procedure.—

Steps	*Items*
1. The skin, subcutaneous fat, and fascia are incised, the bleeding vessels are ligated; skin towels are applied to the wound edges (Figs. 264, 265, 348)	1. Scalpel, tissue forceps, sponges, Roux or Parker retractors, ligatures, chromic gut No. 2-0 or 3-0, scissors, 2 skin towels, towel forceps, 2 tissue forceps, 2 surgical towels, 2 small Richardson or Roux retractors, basin for discarded skin instruments
2. The external oblique fascia is nicked and the internal oblique and transversalis muscles are split and retracted; the peritoneum is grasped and nicked; its edges are grasped and the opening is enlarged and retracted; hemostats are removed (Chapter 11).	2. Crile or Hopkins hemostats, scalpel, Roux or Richardson retractors, scissors, ligature or suture ligature, chromic gut No. 2-0, tissue forceps without teeth, curved scissors, Crile hemostats, small moist pads

Right Hemicolectomy and Ileocolostomy

Definition.—Through a mid-rectus or oblique abdominal incision (Fig. 267), the right half of the colon, including a portion of the transverse colon, the ascending colon, and the cecum, and a segment of the terminal ileum and mesentery are resected, and an anastomosis between the transverse colon and the ileum is accomplished, preferably end-to-end, or side-to-side, or end-to-side occasionally. An ileostomy may be performed, proximal to the anastomosis.

When a side-to-side anastomosis is carried out, the severed stumps of the ileum and the transverse colon are closed before the anastomosis is done. It is completed between the side portions of the ileum and transverse colon. When an end-to-end anastomosis is performed, the layers of the severed stumps of the ileum and the transverse colon are sutured together.

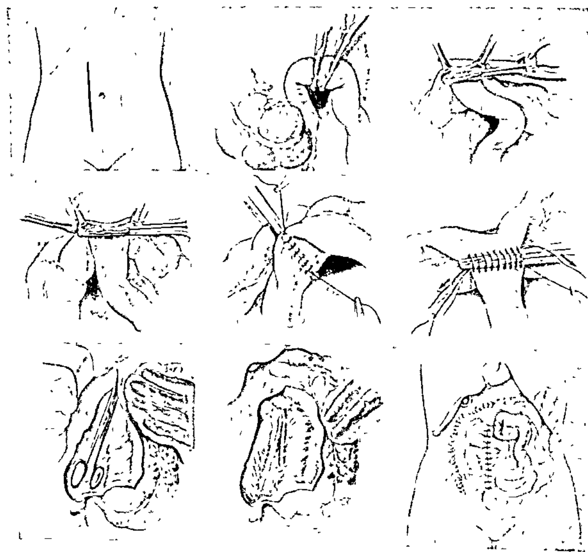


Fig 349—Right hemicolectomy and ileocolostomy The ileocecal region is shown with clamps placed in distal portion of the ileum. The ileum is positioned for anastomosis to the transverse colon After anastomosis is begun and the seromusculature suture is placed, leaving ends of suture long, inverting sutures are placed to include the clamp, then the long sutures are removed Anastomosis is completed (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N J)

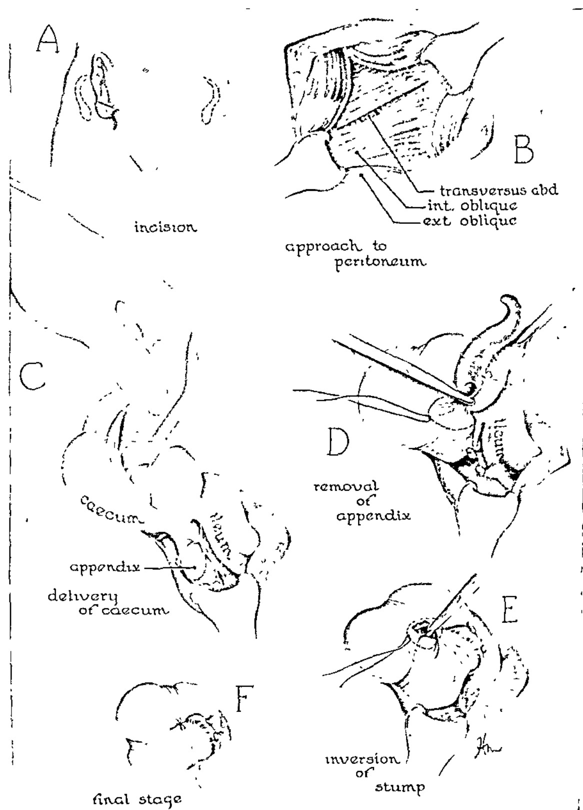
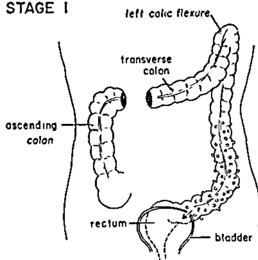


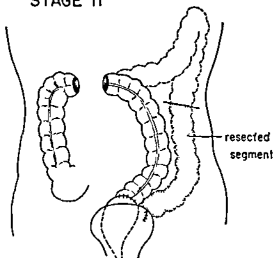
Fig 318 — Stages of appendectomy (From Moseley, H F Textbook of Surgery, St. Louis, 1955, The C V Mosby Co)

Steps	*Items*
9. An end-to-end anastomosis is usually completed between the severed ends of the terminal ileum and the transverse colon by closed or open method (Chapter 12).	9. Rankin or intestinal clamps or Doyen or Scudder rubber-shod clamps, suction set (Chapter 12)
10. Ileostomy may be performed.	10. As for ileostomy operation
11. The mesentery and posterior peritonium are closed with interrupted sutures.	11. Silk No. 3-0, intestinal ½-circle needles, needle holders, scissors, Crile hemostats and tissue forceps
12. The abdominal wound is closed and dressed.	12. As described for closure of celiotomy (Chapter 11)

Diverticulitis of Colon

Complications of diverticulitis of the colon may be treated as shown in Fig. 350, by the following operations: (1) colostomy, (2) resection of the sigmoid colon with anastomosis, and (3) closure of the colostomy.[21]





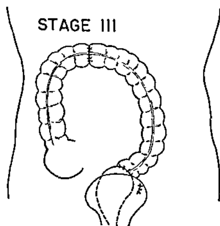


Fig. 350.—[illegible]
left colon at re[illegible]
of sigmoid wit[illegible]
tomy. (From [illegible]

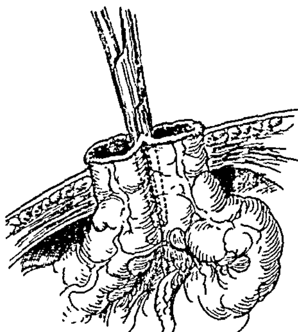
Purposes.—To remove a malignant lesion of the right colon, and, in few cases, to remove an inflammatory lesion which involves the ileum, cecum, and the ascending colon.[2, 8, 17, 20]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal and abdominal surgery (Chapters 11 and 12). Setup listed previously in this chapter. The patient is placed on the operating table in a supine position (Chapter 4), the proposed operative site cleansed (Chapter 3), and the patient draped as described for a celiotomy (Chapter 4).

Operative Procedure.—

Steps	*Items*
1. The abdomen is opened and the peritoneal cavity walled off.	1. As described for opening a celiotomy (Chapter 11)
2. The mesentery of the transverse colon and the terminal ileum are incised at the points where the resection is to be done.	2. Babcock and Allis forceps, a piece of rubber tubing for retraction of intestine, curved scissors, tissue forceps
3. Lateral peritoneal fold along the outer side of the right colon is incised and the right colon mobilized medially. The ureter and the duodenum are identified.	3. Scalpel, curved scissors, Crile or Mayo-Pean hemostats, sponges on holders, laparotomy pads
4. Same procedure is done concerning the terminal ileum.	4. As described for Step 3.
5. Vessels concerned in the resection are clamped and ligated.	5. Mayo-Pean and Crile hemostats, ligatures and suture ligatures, plain No. 0, chromic gut No. 2-0, or silk No. 1 suture ligature threaded on Murphy needle No. 2
6. The ileum is divided between clamps. The severed edges of the ileum above the clamps are removed. The clamp may be left on the distal end of the ileum until the operation is completed	6. Rankin clamp, or 2 Ochsner, Payr, or Allen clamps, moist laparotomy pads, sponges on holders, scalpel or cautery (Chapter 12)
7. The transverse colon is divided between crushing clamp (Fig 349).	7. Payr or Rankin clamp, scalpel or cautery, basin for contaminated items
8. The severed end of the transverse colon is closed over the clamp (aseptic method, Chapter 12) with continuous chromic gut suture and reinforced with second and third rows of interrupted sutures.	8. Chromic gut No. 3-0, 36 inches swaged-on curved intestinal needle; silk No. 3-0, 30 inches swaged-on curved intestinal needle; silk No. 3-0 or 4-0, 12 inches threaded on French-eyed or regular intestinal needles for interrupted sutures (Chapter 12)







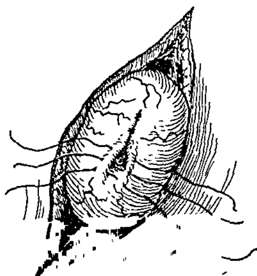


Fig 352 —In partial resection of the colon, using the Mikulicz method, the loop of bowel to be resected is delivered through the wound A crushing clamp is placed on the spur five to nine days after resection has been done (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J.)

Multiple-Stage Resection for Partial Colectomy
(First-Stage Mikulicz Operation)

Definition.—Through a paramedian or left mid-rectus abdominal incision, the involved segment of the colon is exteriorized and divided after the peritoneal cavity is closed.

Purposes.—To treat a carcinoma of the left colon in which primary anastomosis is not to be done. Rankin or other modifications of the Mikulicz operation may be preferred [8, 15]

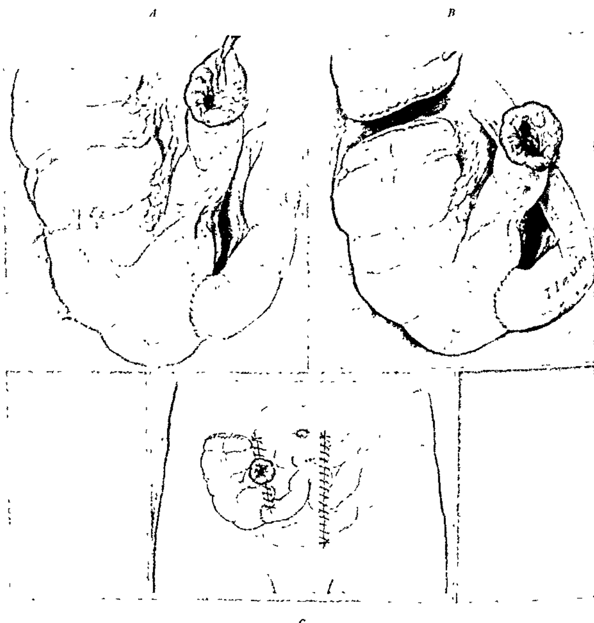
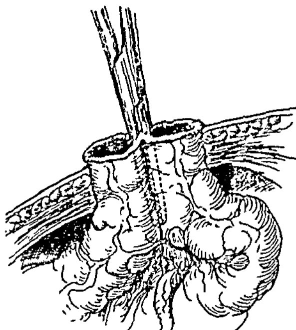
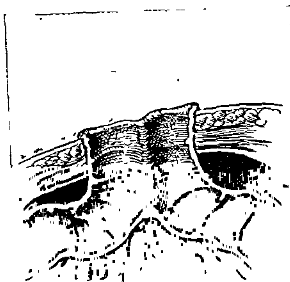


Fig. 351.—In some cases an artificial anus with subtotal colectomy (Spivak) as shown is occasionally performed after the terminal ileum has been divided from the ileocecal valve and the proximal end sutured into the cecum *B*, The distal end of the ileum is brought through the abdominal wall The colon is divided preparatory to resection *C*, Wounds of the artificial anus and the incision through which the colectomy was performed are closed (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N. J.)







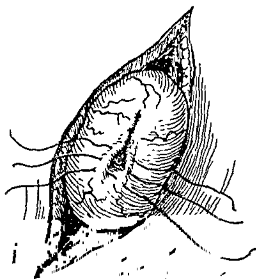


Fig 352—In partial resection of the colon, using the Mikulicz method, the loop of bowel to be resected is delivered through the wound A crushing clamp is placed on the spur five to nine days after resection has been done (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N J.)

Multiple-Stage Resection for Partial Colectomy (First-Stage Mikulicz Operation)

Definition.—Through a paramedian or left mid-rectus abdominal incision, the involved segment of the colon is exteriorized and divided after the peritoneal cavity is closed.

Purposes.—To treat a carcinoma of the left colon in which primary anastomosis is not to be done. Rankin or other modifications of the Mikulicz operation may be preferred [8, 15]

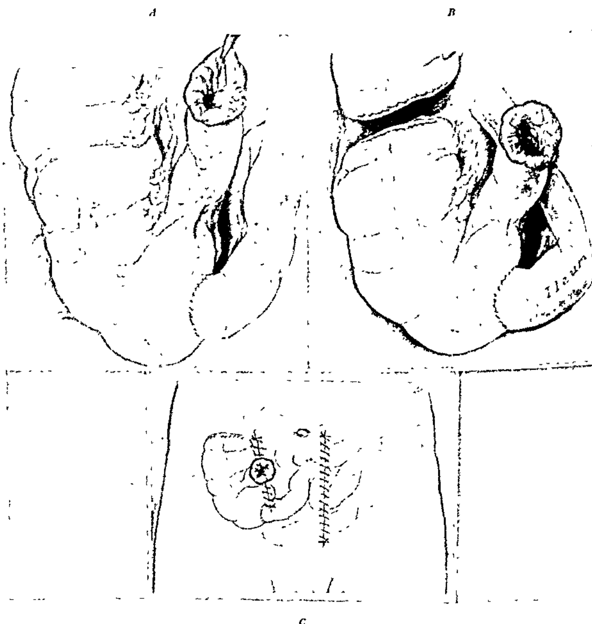


Fig 351—In some cases an artificial anus with subtotal colectomy (Spivak) as shown is occasionally performed after the terminal ileum has been divided from the ileocecal valve and the proximal end sutured into the cecum *B*, The distal end of the ileum is brought through the abdominal wall. The colon is divided preparatory to resection. *C*, Wounds of the artificial anus and the incision through which the colectomy was performed are closed. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J)

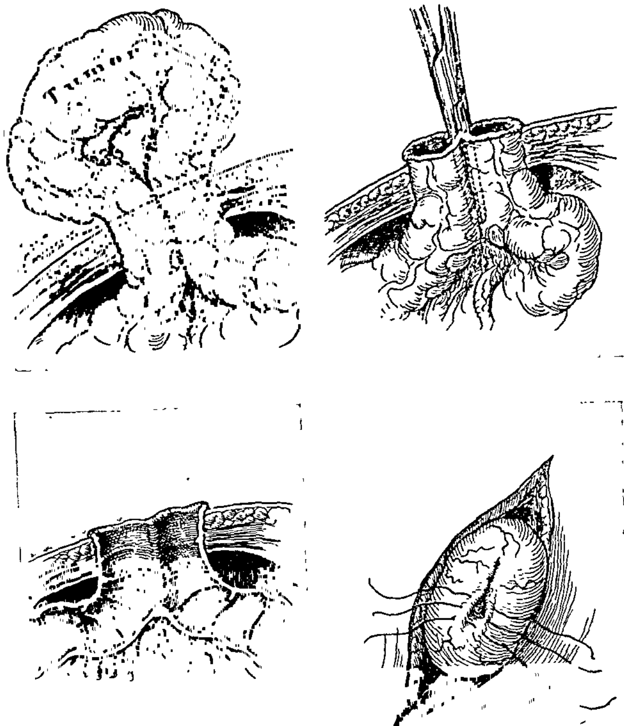


Fig 332 —In partial resection of the colon, using the Mikulicz method, the loop of bowel to be resected is delivered through the wound A crushing clamp is placed on the spur five to nine days after resection has been done. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc , Somerville, N J)

Multiple-Stage Resection for Partial Colectomy
(First-Stage Mikulicz Operation)

Definition.—Through a paramedian or left mid-rectus abdominal incision, the involved segment of the colon is exteriorized and divided after the peritoneal cavity is closed.

Purposes.—To treat a carcinoma of the left colon in which primary anastomosis is not to be done. Rankin or other modifications of the Mikulicz operation may be preferred.[8, 15]

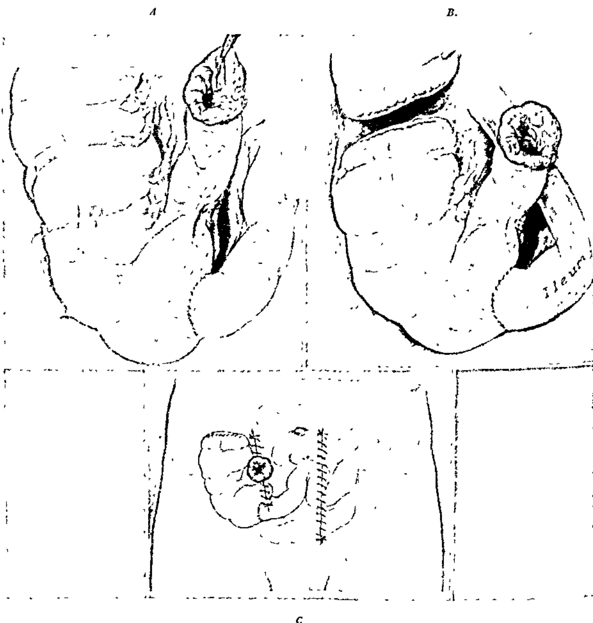
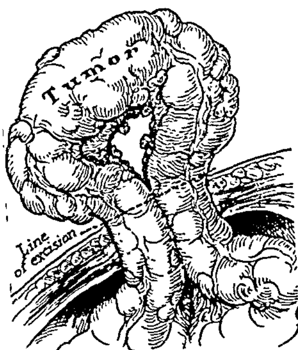
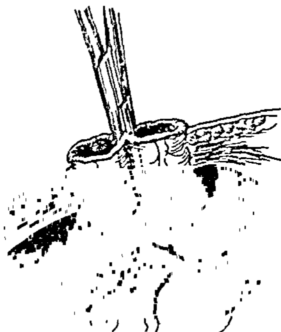
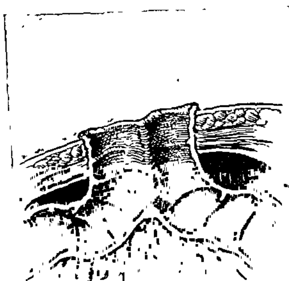


Fig 351.—In some cases an artificial anus with subtotal colectomy (Spivak) as shown is occasionally performed after the terminal ileum has been divided from the ileocecal valve and the proximal end sutured into the cecum *B*, The distal end of the ileum is brought through the abdominal wall. The colon is divided preparatory to resection *C*, Wounds of the artificial anus and the incision through which the colectomy was performed are closed. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J)







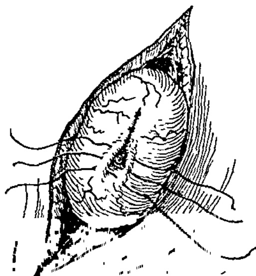


Fig 352 —In partial resection of the colon, using the Mikulicz method, the loop of bowel to be resected is delivered through the wound. A crushing clamp is placed on the spur five to nine days after resection has been done (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J)

Multiple-Stage Resection for Partial Colectomy
(First-Stage Mikulicz Operation)

Definition.—Through a paramedian or left mid-rectus abdominal incision, the involved segment of the colon is exteriorized and divided after the peritoneal cavity is closed.

Purposes.—To treat a carcinoma of the left colon in which primary anastomosis is not to be done. Rankin or other modifications of the Mikulicz operation may be preferred.[8, 15]

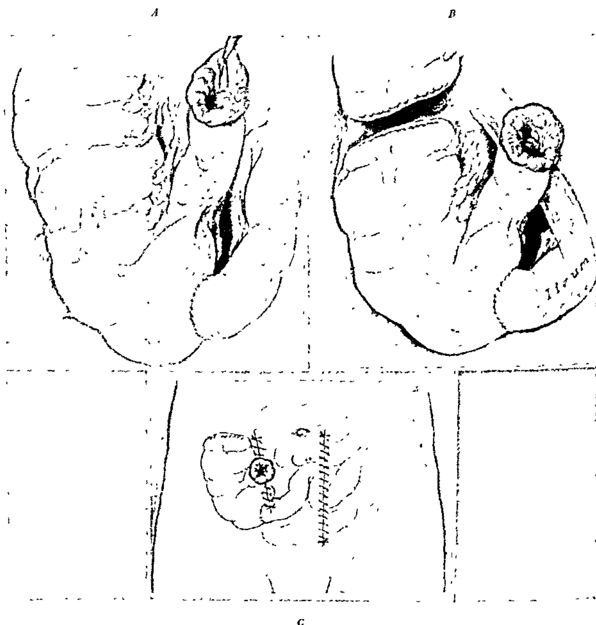


Fig 351.—In some cases an artificial anus with subtotal colectomy (Spivak) as shown is occasionally performed after the terminal ileum has been divided from the ileocecal valve and the proximal end sutured into the cecum *B*, The distal end of the ileum is brought through the abdominal wall The colon is divided preparatory to resection. *C*, Wounds of the artificial anus and the incision through which the colectomy was performed are closed. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc, Somerville, N. J)

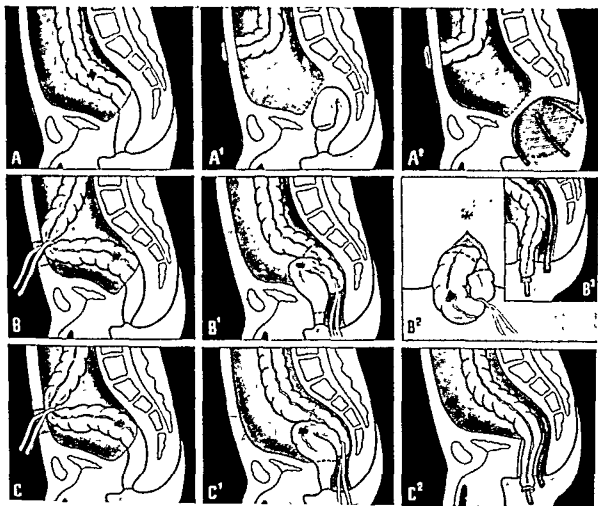


Fig. 353.—Combined abdominoperineal operations for carcinoma of the rectum or rectosigmoid.

A, The Miles operation. *A¹*, The abdominal portion of the operation has been completed. The divided sigmoid has been placed beneath the reconstructed pelvic floor and a colostomy has been formed. *A²*, The perineal part of the operation. The sigmoid, rectum, and anus have been removed and drains have been placed in the perineal cavity. The operation may be performed in *one or two stages.*

B, The Babcock operation The iliac and pelvic colon have been freed through the abdominal *incision. B¹*, The perineal part of the operation The freed colon and rectum are brought out through a perineal incision *B²*, The colon and rectum are removed down to the sphincter which is split posteriorly. *B³*, The proximal colon is brought down through the sphincter

C, The Hochenegg or "durchzug" operation. The abdominal part is shown. *C¹*, The sigmoid is brought out through a perineal incision and removed, leaving a cuff of rectum. *C²*, The proximal colon is brought down through this small portion of remaining rectum and out through the sphincter. (From Berman, J. K.. Principles and Practice of Surgery, St. Louis, 1950, The C. V. Mosby Co)

Setup, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery (Chapters 11 and 12). Setup as listed previously in this chapter. The preventive measures described in Chapters 3, 4, and 12 are carried out.

Operative Procedure.—

Steps	*Items*
1. The abdominal cavity is opened and the wound edges are protected by towels. The wound is retracted and the cavity explored.	1. *As described for opening of celiotomy* (Chapter 11)
2. The lesion is identified and mobilized by division of the peritoneal folds. The mesentery that surrounds the lesion is incised at its route and is divided between clamps. The rent in the mesentery is closed.	2. Allis and Babcock forceps, laparotomy pads, long scissors, Crile hemostats, ligatures, scalpel, Mayo-Pean hemostats, chromic gut No. 3-0 suture, needle holder, scissors
3. The Mikulicz procedure: A double-barrelled spur is formed by joining distal and proximal segments above and below the portion of bowel to be removed by placement of mattress sutures in the serosal layers. The wound is closed around the exteriorized segments of the colon.	3. Chromic gut No. 2-0 swaged-on intestinal needle; items for closure of wound (Chapter 11)
4. The freed colon is mobilized and divided and the diseased segment of colon with its mesentery removed. Dressings are applied.	4. Rankin clamp or Ochsner or Allen clamps, scalpel or cautery, and dressings

Combined Abdominoperineal Resection (Miles Operation)

Definition.—Through a low paramedian abdominal incision, extending from the pubis above the level of the umbilicus, the diseased segment of the lower bowel is mobilized and divided. The proximal end is exteriorized as a single-barrelled colostomy, the distal end is pushed into the hollow of the sacrum and then removed through the perineal route

Purpose.—To remove a malignant lesion in the rectum or the rectosigmoid colon.[2, 8, 11, 15]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for gastrointestinal surgery (Chapter 12). Setup as listed previously in this chapter. A slight Trendelenburg position is used for the abdominal stage of the operation (Chapter 15) and a lithotomy or Sims position for the perineal operation (Chapter 15).

Steps	*Items*
13. The omentum is brought down to the pelvis and the abdominal wound closed and dressed.	13. Sutures for abdominal closure; petrolatum gauze may be placed around the permanent colostomy abdominal wound dressings (Chapter 11)

B. Operative Procedure for Perineal Operation.—

Steps	*Items*
1. The patient is placed on the operating table in a Sims or lithotomy position (Chapter 15). The anus is usually closed by a pursestring suture. The surgeon then changes his gown and gloves.	1. Silk No. 0 threaded on cutting-edge 3/8-circle needle, needle holder, tissue forceps, scissors and sponges, basin for soiled items
2. The perineal area is cleansed and the patient draped with towels and a fenestrated sheet.	2. Routine skin preparation tray, lithotomy or laparotomy sheet
3. An elliptical incision is made around the anus and carried through the subcutaneous tissue. Superficial bleeding vessels and the inferior hemorroidal vessels are clamped, divided, and ligated.	3. Scalpel, tissue forceps, Crile hemostats, retractors, sponges on holders, Mayo-Pean hemostats, heavy scissors, chromic gut No. 0 or 1
4. The levator ani muscles are divided at their point of attachment to the rectal wall (Figs. 339, 340).	4. Curved scissors, Mayo-Pean hemostats, sponges, long bladed rectal retractor, small laparotomy pad.
5. In a few cases the coccyx and lower portion of the sacrum may be removed to facilitate exposure.	5 Sharp and blunt periosteal elevators, bone-cutting forceps, rongeur
6. The anterior wall is dissected free from the prostate gland (in men) or from the vaginal wall (in women).	6. Long curved scissors, long tissue forceps, sponges on holders, and long curved clamps
7. The upper end of the distal bowel, containing the tumor, is grasped, delivered into the perineal wound, and removed (Fig. 353). The bleeding vessels are ligated and the perineal defect is packed or partially sutured Drainage is established.	7 Allis-Adair forceps, Kelly tissue forceps, chromic gut No. 0, scissors, plain gauze or iodoform packing, rubber tissue, if desired, urethral catheters, Foley No. 16 F, chromic gut sutures No. 2-0, needle holder, scissors

Abdominoperineal Operation With Preservation of the Sphincter

During the abdominal operation a colostomy is not done. In the perineal part the rectum and the internal anal sphincter are freed and the proximal end of the sigmoid is drawn through the external anal sphincter by long Allis-

A. Operative Procedure for the Abdominal Operation.—

Steps	*Items*
1. The abdomen is opened and the peritoneal cavity explored to determine the presence of liver metastasis.	1. As described for opening of a celiotomy (Chapter 11)
2. The loop of the sigmoid is grasped and the small intestines are walled off.	2. Allis or Babcock forceps, laparotomy pads, Deaver or self-retaining retractors
3. The peritoneum on the left side of the mesocolon is incised and the incision extended into the pelvis.	3. Curved scissors, tissue forceps, Crile hemostats, ligatures, plain No. 0 and chromic gut No. 2-0 or silk No. 3-0
4. Pelvic peritoneum is dissected free to form the left side of the new pelvic floor. Bleeding vessels are ligated.	4. Deep-bladed retractors, long scissors and tissue forceps, laparotomy pad, Mayo-Pean hemostats, long ligatures
5. The sigmoid is turned toward the left and the same procedure as in Step 4 is carried out on the right side of the pelvis. The two incisions are then curved and joined in front of the rectum.	
6. The superior hemorrhoidal blood vessels are doubly ligated and divided	6. Sponges on holders, curved scissors, long Mayo-Pean hemostats, long ligatures, chromic gut No. 0 or silk No. 2-0
7. The rectum is freed anteriorly and posteriorly with the glands from the adjacent structures down to the sacrococcygeal junction.	7. Long curved scissors and tissue forceps, sponges on holders, long Mayo-Pean hemostats
8. The sigmoid is doubly clamped and divided with the cautery.	8. 2 Laparotomy pads, Payr clamps or Furniss-Clute clamp, *aseptic anastomosis method* (Chapter 12)
9. The proximal end with clamp attached is brought out of the wound and serves as a permanent colostomy.	
10. *The round end may be brought* through a small left McBurney incision.	10. *Scalpel, curved scissors,* Crile hemostats, tissue forceps
11. The distal divided end of the sigmoid is ligated and covered or sutured; then it is placed in the pelvis.	11. Chromic gut No. 2-0 or silk No 3-0 swaged-on needles, or piece of rubber dam or other material and heavy silk
12 The pelvic peritoneum is closed over the distal divided end to make a new floor.	12 Continuous or interrupted sutures, chromic gut No. 0 or 2-0 or silk No. 3-0 swaged-on heavy needle ½-circle taper-point, long needle holder and tissue forceps, sponges on holders, scissors; items for closure of celiotomy (Chapter 11)

Steps	*Items*
2. The tract is incised.	2. Probe, grooved director, knife
3. The fibrous wall of the sinus is dissected out.	3. Curved scissors, tissue forceps, curette, knife, Crile hemostat
4. The resulting cavity is packed.	4. Iodoform gauze packing and petrolatum gauze dressing



Fig 355.—A sinus in the anal canal (E H Terrell) (From Horsley, G. W., and Bigger, I. A: Operative Surgery, St Louis, 1953, The C V. Mosby Co)

Drainage of Ischiorectal Abscess

Definition.—Opening and drainage of the abscess cavity in the ischiorectal space.

Setup, Position, Skin Preparation, Draping Procedure.—Setup as listed previously in this chapter. The patient is prepared for surgery as described for hemorrhoidectomy.

Operative Procedure.—

Steps	*Items*
1. A radial incision is made over the site near the anus (Figs 338 and 355).	1. Scalpel, tissue forceps, gauze
2. The abscess cavity is explored and opened.	2. Curette, curved scissors, Mayo-Pean hemostat.

Steps	*Items*
6. A ligature is placed through the proximal end of the hemorrhoid under the clamp; the short end is then clamped and the needle left on the long end.	6. Surgical gut, plain No. 0, chromic gut No. 2-0 or 3-0, or linen threaded on Mayo needle No. 4, Murphy needle No. 3, or swaged-on needle, suture, needle holder, tissue forceps, Crile hemostat, gauze sponges
7. The hemorrhoid is excised above the clamp and a suture run as a continuous suture over the clamp end. The clamp is removed.	7. Knife, needle holder
8. The suture is tightened and the ends cut. Additional sutures may be used to control bleeding or to close the skin	8. Interrupted suture, surgical gut plain No. 0 or 2-0 or chromic gut No. 3-0, threaded on curved Murphy needle No. 3, tissue forceps, scissors.
9 Remaining hemorrhoids are ligated in a similar manner.	9. Petrolatum or plain gauze packing, dressing and T binder

Operative Procedure for Thrombosed Hemorrhoids

Definition.—Incision and evacuation of a thrombosed hemorrhoidal vein.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as listed previously in this chapter. The patient is placed on the operating table in a Sims or lithotomy position. The area is not shaved but cleansed in the routine manner. The patient is draped with regular sheets or a fenestrated sheet.

Operative Procedure.—

Steps	*Items*
1 The incision is made directly over the area of the thrombosis. The tissue edges are grasped	1. Scalpel, gauze sponges, tissue forceps, Crile hemostats
2 The blood clot is removed.	2. Tissue forceps without teeth, curette, or gauze sponge
3 The cavity is packed; dressings and binder are applied.	3. Plain or iodoform packing, tissue forceps, scissors, 4 by 8 inch compresses, T-binder, 2 safety pins

Excision of Fistula-in-Ano

Definition.—Resection and removal of anal fistula.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for hemorrhoidectomy, plus a 2 ml hypodermic syringe and blunt needle for injection of a dye solution such as methylene blue.

Operative Procedure.—

Steps	*Items*
1. The sphincter muscle is dilated. The fistulous opening is injected with dye or probed.	1. Self-retaining retractor, methylene blue solution, probe

Steps	*Items*
2. The tract is incised.	2. Probe, grooved director, knife
3. The fibrous wall of the sinus is dissected out.	3. Curved scissors, tissue forceps, curette, knife, Crile hemostat
4. The resulting cavity is packed.	4. Iodoform gauze packing and petrolatum gauze dressing



Fig 355.—A sinus in the anal canal (E H Terrell) (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, St. Louis, 1953, The C V Mosby Co)

Drainage of Ischiorectal Abscess

Definition.—Opening and drainage of the abscess cavity in the ischiorectal space.

Setup, Position, Skin Preparation, Draping Procedure.—Setup as listed previously in this chapter. The patient is prepared for surgery as described for hemorrhoidectomy.

Operative Procedure.—

Steps	*Items*
1. A radial incision is made over the site near the anus (Figs. 338 and 355).	1. Scalpel, tissue forceps, gauze
2. The abscess cavity is explored and opened.	2. Curette, curved scissors, Mayo-Pean hemostat.

Steps	*Items*
3. A drain or packing is inserted in the cavity.	3. Iodoform, petrolatum, or plain gauze packing.
4. The wound is left open. Sutures may be placed to anchor drains.	4. Interrupted sutures, plain No. 0 threaded on a Mayo needle No. 4 on needle holder, scissors, tissue forceps, dressings

REFERENCES

1. Bockus, H L · Gastro-enterology, Philadelphia, 1946, W. B Saunders Co, vol II
2. Moseley, H F: Textbook of Surgery, ed. 2, St. Louis, 1956, The C. V. Mosby Co.
3. Thorek, M.: Modern Surgical Technic, Philadelphia, 1949, J. B. Lippincott Co.
4. Best, C. H, and Taylor, N. B.: Physiological Bases of Medical Practice, Baltimore, 1953, Williams & Wilkins Co.
5. Anthony, C. P.: Textbook of Anatomy and Physiology, ed 4, St. Louis, 1955, The C. V. Mosby Co.
6. Bacon, H. E: Anus, Rectum, and Sigmoid Colon, ed 3, Philadephia, 1949, J. B. Lippincott Co
7. Lyons, A. S.· Functions and Diseases of Anorectum and Colon, S Clin. North America 10:1411, 1955.
8. Rankin, F W, and Graham, A: Cancer of the Colon and Rectum, ed 2, Springfield, Ill, 1950, Charles C Thomas, Publisher.
9. Bacon, H. E, and Ross, S.: Atlas of Operative Technic: Anus, Rectum, and Colon, St. Louis, 1954, The C. V. Mosby Co.
10. Gabriel, W. B: Rectal Surgery, ed. 4, Springfield, Ill, 1948, Charles C Thomas, Publisher
11. Gilchrist, W. B: The Principles and Practice of Rectal Surgery, ed. 3, London, 1945, H. K. Lewis & Co, Ltd.
12. Ladd, W E., and Gross, R. E: Abdominal Surgery in Infancy and Childhood, Philadelphia, 1952, W. B. Saunders Co
13. Gross, R. E: The Surgery of Infancy and Childhood. Its Principles and Techniques, Philadelphia, 1953, W B Saunders Co, chaps. 12-16, 18-22, 24.
14. Maingot, R· Abdominal Operations, ed. 3, New York, 1955, Appleton-Century-Crofts, Inc, chap. 67.
15. Spivak, S. L.: The Surgical Technic of Abdominal Operations, ed. 5, Springfield, Ill, 1955, Charles C Thomas, Publisher.
16. Shackelford, R T, and Dugan, H. J. Bickham-Callander Surgery of the Alimentary Tract, Philadelphia, 1955, W. B Saunders Co., vol. II, chaps. 7-9; vol. III, chaps 10, 11, 13.
17. Mayo, C W The Small and Large Intestine, Chicago, 1955, Year Book Publishers, Inc.
18. Lichtensen, M E· Colostomy, S. Clin North America 10:1347, 1955.
19. Richards, V Surgery in General Practice, St Louis, 1956, The C. V. Mosby Co.
20. Wangensteen, O H, and Toon, R W. Primary Resection of the Colon and Rectum With Particular Reference to Cancer and Ulcerative Colitis, Am. J Surg. 75:384, 1948.
21. Patterson, H A Management of Complications of Diverticulitis of Colon, S. Clin. North America 4:451, 1955.
22. Swinton, N W The Management of Rectal Polyps, S Clin. North America 6:751, 1956.
23. Cantor, A J· Ambulatory Proctology, New York, 1952, Paul B Hoeber, Inc.
24. Swinton, N. W, and Mumma, L F The Treatment of Hemorrhoids, S. Clin. North America 6:761, 1956

CHAPTER 15

OPERATIONS ON THE FEMALE REPRODUCTIVE ORGANS

ANATOMY

In the adult female the anatomic structures directly associated with the process of reproduction include the following: the bony pelvis and its ligaments and muscles, the soft tissues and the contents of the pelvis known as the internal genitals, the external genitals, and the breasts.[1-6] In the presence of a lesion it may be necessary to perform surgery on one or more of the reproductive organs and associated tissues, as well as on other organs such as the bladder and rectum. Knowledge of the normal anatomy and physiology of the reproductive system in the female is most helpful to the nurse in understanding the purpose and operation, and the nursing duties to be performed in caring for each patient (Figs. 356 and 357).[7-9]

The Pelvis

In relation to surgery, the pelvic brim divides the pelvis into two parts. The upper portion is known as the false pelvis and the portion below, the true pelvis. The false pelvis is surrounded by the flaring innominate bones (one hip bone) on each side, the sacrum and coccyx in back, and the abdominal muscles in front (Fig. 357). The genital organs and other abdominal contents are protected from accidental injury and supported by the bony rigid framework. The false pelvis, to a small degree, affects the process of childbearing.

The true pelvis, which forms the passageway through which the baby passes during parturition, is divided into three portions: the inlet (pelvic brim), a cavity, and an outlet. The true pelvis contains some of the reproductive organs, the bladder, and the rectum. In the female, the urinary tract is entirely separate from the genital tract (Chapter 16).

The Pelvic Floor

The organs lying in the true pelvis are supported by connective tissue composed of ligaments and fascia. The levator ani muscles form a broad scooping sling effect from the bony lateral walls of the pelvis, pass downward and inward to unite with the fascia and muscles of the opposite side, or attach to the sacrum and coccyx laterally. The united levator ani muscles pass around the anus and vaginal outlet (Figs. 357 and 358). The muscles of the pelvic floor give additional support to the vagina, rectum, bladder, and uterus (Fig. 359).

Steps	*Items*
3. A drain or packing is inserted in the cavity.	3. Iodoform, petrolatum, or plain gauze packing.
4. The wound is left open. Sutures may be placed to anchor drains.	4. Interrupted sutures, plain No. 0 threaded on a Mayo needle No. 4 on needle holder, scissors, tissue forceps, dressings

REFERENCES

1. Bockus, H L: Gastro enterology, Philadelphia, 1946, W. B Saunders Co, vol. II.
2. Moseley, H. F: Textbook of Surgery, ed. 2, St. Louis, 1956, The C. V. Mosby Co
3. Thorek, M: Modern Surgical Technic, Philadelphia, 1949, J. B. Lippincott Co.
4. Best, C. H, and Taylor, N. B: Physiological Bases of Medical Practice, Baltimore, 1955, Williams & Wilkins Co.
5. Anthony, C. P.: Textbook of Anatomy and Physiology, ed. 4, St. Louis, 1955, The C. V. Mosby Co.
6. Bacon, H. E.: Anus, Rectum, and Sigmoid Colon, ed. 3, Philadephia, 1949, J. B Lippincott Co.
7. Lyons, A. S: Functions and Diseases of Anorectum and Colon, S. Clin. North America 10:1411, 1955.
8. Rankin, F W., and Graham, A: Cancer of the Colon and Rectum, ed. 2, Springfield, Ill, 1950, Charles C Thomas, Publisher.
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11. Gilchrist, W. B: The Principles and Practice of Rectal Surgery, ed. 3, London, 1945, H. K. Lewis & Co, Ltd.
12. Ladd, W E., and Gross, R. E: Abdominal Surgery in Infancy and Childhood, Philadelphia, 1952, W. B Saunders Co
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17. Mayo, C. W.: The Small and Large Intestine, Chicago, 1955, Year Book Publishers, Inc.
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21. Patterson, H A: Management of Complications of Diverticulitis of Colon, S. Clin. North America 4:451, 1955
22. Swinton, N. W.. The Management of Rectal Polyps, S Clin. North America 6:751, 1956
23. Cantor, A J.: Ambulatory Proctology, New York, 1952, Paul B Hoeber, Inc.
24. Swinton, N. W., and Mumma, L. F.. The Treatment of Hemorrhoids, S. Clin. North America 6 761, 1956.

CHAPTER 15

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Epoaphoron
Proper ovarian ligament
Uterus
Epoaphoron
Fallopian tube
Meso-salpinx
Ovary
Hydatide of Morgagni
Round ligament
Cervix
Broad ligament
External uterine orifice
Vagina
Vaginal rugae
Prepuce of the clitoris
Labium majus
External urethral orifice
Labium minus
Hymenal caruncles
Introitus of the vagina
Posterior commissure
Frenulum of the labia

Fig 356—The female reproductive organs (Courtesy Rubin, I C., and Novak, J. Integrated Gynecology, vol I, copyright, 1956, Blakiston Division, McGraw-Hill Book Co, Inc)

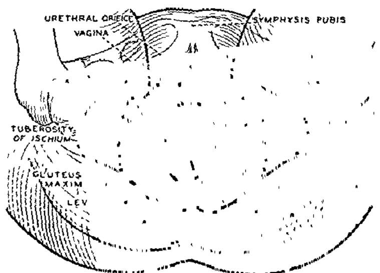


Fig 357—Topographic anatomy of the important perineal structures (From Greenhill, J. P: Surgical Gynecology, Chicago, 1957, The Year Book Publishers, Inc)



Fig 358.—Topographic anatomy. The left half of the figure shows the nerve supply of the *perineum, particularly the inferior hemorrhoidal, the perineal, and the ilioinguinal nerves* On the right is shown the site for injecting a local anesthetic into these nerves. (From Greenhill, J P.: Surgical Gynecology, Chicago, 1957, The Year Book Publishers, Inc)

Fig 359.—The relationship of the levator ani muscles and vagina as seen from below. Inset: Same relationship as seen in a frontal section (Modified from original by Tom Jones in Camp Anatomical Studies; from Crossen, R. J.: Diseases of Women, St. Louis, 1953, The C. V.

Epoophoron
Proper ovarian ligament
Uterus
Epoophoron
Fallopian tube
Meso-salpinx
Ovary
Hydatide of Morgagni
Cervix
Round ligament
Broad
External uterine orifice
Vagina
Labium majus
External urethral orifice
Labium minus
Hymenal caruncles
Introitus of the vagina
Posterior commissure
Frenulum of the labia

Fig 356 —The female reproductive organs (Courtesy Rubin, I C., and Novak, J.. Integrated Gynecology, vol I, copyright, 1956, Blakiston Division, McGraw-Hill Book Co, Inc)

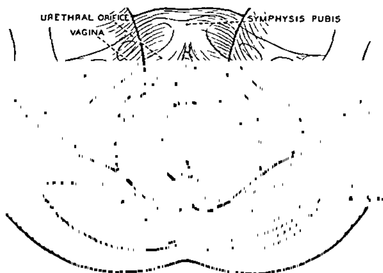


Fig 357.—Topographic anatomy of the important perineal structures (From Greenhill, J P: Surgical Gynecology, Chicago, 1957, The Year Book Publishers, Inc)

gradually disappear in the tissues to form the anterior border of the perineal body. These two thick folds, consisting of skin, connective tissue, fat, and many blood vessels, are covered with hair on their outer surfaces but are smooth and moist on their inner surfaces. On either side of the labia majora there is the Bartholin's gland (Fig. 356).

Labia Minora.—The labia minora, consisting of two thin folds of skin, are situated between the labia majora. The outer surfaces of the labia minora are associated with the inner surfaces of the labia majora. In the upper portion the two labia minora join above and below the clitoris to form the prepuce, consisting of skin and tissue. In the lower portion the labia minora are very thin and unite to form the anterior edge of the perineal body. This portion of skin is called the fourchet (Fig. 356).

Clitoris.—The clitoris, a sensitive organ, composed of erectile tissue, nerves, and blood vessels, is attached to the undersurface of the pubis.

Vestibule.—The vestibule is a term applied to the cavity situated between the labia minora and the posterior fourchet. Within the vestibule there are the openings of the urethra, vagina, and the ducts from the two Bartholin's glands.

Hymen.—The hymen, composed of mucous membrane, forms the floor of the vestibule, and acts as a partition between the external genital organs and the vagina and internal organs (Fig. 356).

Urethra.—The urethra connects the bladder with the outside and acts as the excretory duct of the bladder (Chapter 16). At each side of the urethra there are two small openings which are the ducts to the Skene's glands.[6,7]

The Internal Genital Organs

The internal organs of reproduction in the female are the vagina, the uterus, the fallopian tubes, and the ovaries.[2,10]

Vagina.—The vagina, a tubelike organ about four inches long, is situated between the external genitals and the other internal organs. It extends from the cervix of the uterus down and forward to the hymenal orifice. The vagina, lying between the bladder and the rectum, is closely associated with the portion of the peritoneum known as the cul-de-sac of Douglas (Fig. 361). The ureters pass on either side of the upper portion of the vaginal wall, which is composed of elastic connective tissue and an abundant blood supply from several arteries. These include the cervicovaginal branch of the uterine artery and the inferior vesical, middle hemorrhoidal, and internal pudendal arteries (Fig. 362).

Uterus and Supporting Ligaments.—The uterus is a hollow muscular organ lying within the true pelvic cavity behind the bladder and in front of the lower portion of the sigmoid colon (rectum) (Fig. 361).

The uterus, which is partially covered with peritoneum, is suspended and stabilized in the pelvic cavity by means of five pairs of ligaments. They are the broad, round, uterosacral, cardinal, and vesicouterine ligaments.

The round ligaments arise neutrally at a point where the fallopian tube enters the uterus, pass through the folds of the broad ligament, laterally and forward through the inguinal ring, down the inguinal canal, and disappear by

The pelvic fascia, which is distributed in the basin-shaped pelvis, may be divided into three groups: (1) the parietal fascia covering the muscles of the pelvic cavity, (2) the diaphragmatic fascia covering the pelvic diaphragm, and (3) the endopelvic or visceral fascia covering the pelvic viscera (Fig. 360). The reader should review the muscles of the pelvic floor in the standard anatomy textbooks.

The External Genital Organs

The term vulva is generally applied to the external genital organs. These include the perineal body (perineum), mons veneris, labia majora and labia minora, clitoris, hymen, and external urinary meatus (Fig. 356).

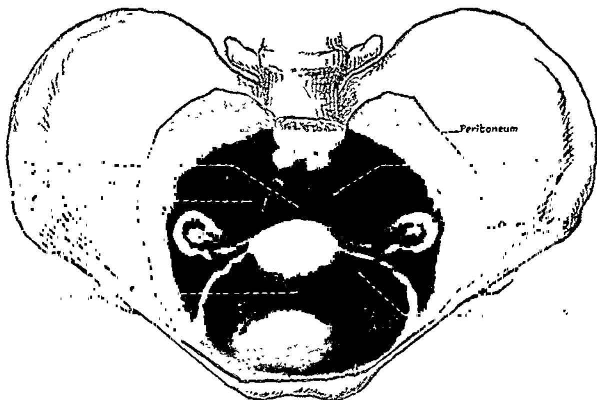


Fig. 360.—The distribution of the peritoneum within the pelvis and the various ligaments and pouches thus formed. It is as though a thin cloth were laid over the pelvis and then tucked in around all the organs and their wall connections. (From Crossen, R. J.: Diseases of Women, St. Louis, 1953, The C. V. Mosby Co.)

Perineum.—The outlet of the bony pelvis is covered with muscles, tissue, and skin. Situated between the external genital organs and the rectum there is a perineal body composed of muscles, fascia, fat, and skin. It is sometimes impaired as a result of childbearing. A perineorrhaphy means a repair of lacerations of the perineum. In such cases, other perineal structures are not injured.[3, 6, 10]

Mons Veneris.—The mons veneris, composed of firm tissue, skin and hair, covers the symphysis pubis

Labia Majora.—The labia majora consist of two longitudinal folds of skin that extend downward and backward from the mons veneris. These folds

gradually disappear in the tissues to form the anterior border of the perineal body. These two thick folds, consisting of skin, connective tissue, fat, and many blood vessels, are covered with hair on their outer surfaces but are smooth and moist on their inner surfaces. On either side of the labia majora there is the Bartholin's gland (Fig. 356).

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The round ligaments arise neutrally at a point where the fallopian tube enters the uterus, pass through the folds of the broad ligament, laterally and forward through the inguinal ring, down the inguinal canal, and disappear by

splitting into fibers within the labia majora (Fig. 361). These ligaments are composed of peritoneal folds and at their base contain a few muscle fibers, uterine arteries, veins, lymphatics, and ureters. These ligaments help to keep the uterus in normal position.

The sacrouterine ligaments, composed of peritoneal folds, leave the uterus at its posterior wall near the level of the internal os, pass posteriorly and laterally, separate into fibers, and unite with the peritoneal covering lying over the *sacroiliac joints* *The space existing between the two sacrouterine ligaments forms* the so-called cul-de-sac or pouch of Douglas (Figs. 360 and 361).

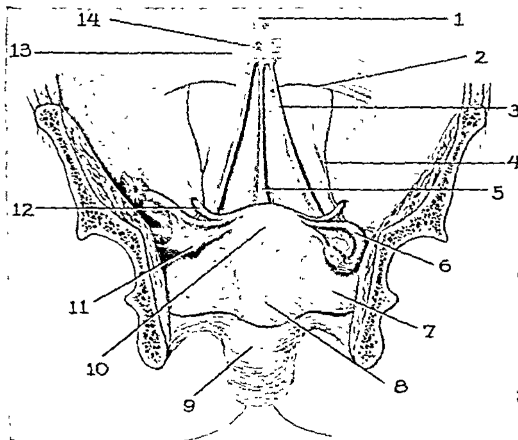


Fig 361 —The relationship of the female sexual organs to the anterior abdominal wall. *1*, round ligament and liver *2*, semicircular line of Douglas, *3*, lateral umbilical ligament; *4* inferior epigastric artery, *5* medial umbilical ligament; *6*, fallopian tube; *7*, broad ligament; *8*, cervix; *9*, vagina *10*, uterine corpus *11*, ovary; *12*, round ligament; *13*, umbilical fascia; *14*, umbilicus. (Courtesy Rubin I C, and Novak, J Integrated Gynecology, vol. I, copyright, 1956, Blakiston Division, McGraw Hill Book Co, Inc)

The cardinal ligaments leave the lower part of the uterus (cervix) and the upper part of the vagina, spread out transversely, pass toward the bony wall of the pelvis, and end in the fascia of the pelvic diaphragm. The cardinal ligaments, which lie at the base of the broad ligaments, are composed of a few fiber muscles, many blood vessels, nerves, and connective tissue.

The vesicouterine ligaments or the peritoneal folds lie anterior to the uterus. They pass forward and detach themselves to the lateral aspects of the bladder.

Structures of the Uterus.—The uterus is divided by a shallow constriction into an upper wide portion and a narrow cylindrical segment. The upper part is called the body of the uterus, of which the uppermost part is known as the fundus. The lower part of the uterus is called the cervix, which comprises three segments. The cervix is a passageway with constrictions at the upper and lower ends. These constrictions form the so-called internal os and external os.

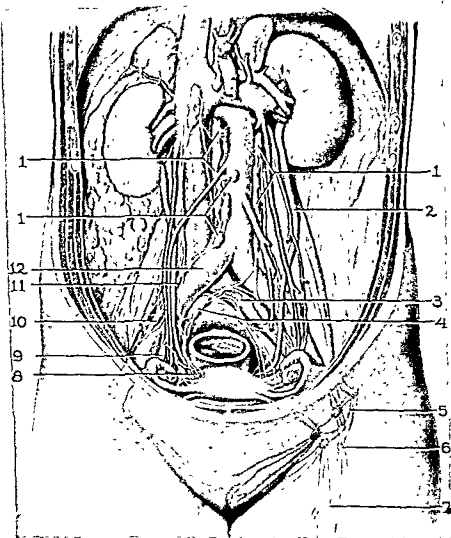


Fig 362.—The lymphatic system of the abdomen and pelvis: *1*, lumbar or aortic nodes, *2*, ureter, *3*, common iliac vein, *4*, sacral lymph nodes; *5*, inguinal lymph nodes, *6*, subinguinal or inguinofemoral lymph nodes, *7*, femoral lymph nodes, *8*, parometric gland of Championnière; *9*, hypogastric lymph node; *10*, external iliac lymph nodes, *11*, common iliac lymph nodes; *12*, common iliac artery. (Courtesy Rubin, I C, and Novak, J: Integrated Gynecology, vol I, copyright, 1956, Blakiston Division, McGraw-Hill Book Co, Inc)

The walls of the uterus include (1) an external peritoneal covering (perimetrium or serous layer), which is a reflection of the pelvic peritoneum (Fig. 360), (2) a middle strong muscular layer (myometrium) containing involuntary muscles, nerves, blood vessels, and lymphatics (Fig. 362), and (3) an internal mucosal layer (endometrium), which is ocntinuous with the mucous membranes of the fallopian tubes and cervix.

Within the upper portion of the uterus there are two openings that communicate with the fallopian tubes and one opening at the bottom that communicates with the vagina through the cervix.

The arterial blood supply of the uterus is derived from branches of the abdominal aorta and from the hypogastric and ovarian arteries. The venous blood of the uterus, tubes, and ovaries collects in the ovarian plexus that accompanies the ovarian arteries. The blood flows on the right side directly into the inferior vena cava and on the left side into the renal vein.

Ovaries and the Fallopian Tubes.—These organs are called the adnexa of the uterus. The two firm ovaries lie normally in a depression of the lateral pelvic wall. They are supported and stabilized by the ovarian or suspensory ligaments consisting of fibrous tissue. The external iliac vessel is above and in front of each ovary, the hypogastric vessels in back, and the uterine and umbilical arteries below. The right tube and ovary are in close relationship to the cecum and appendix, and the left adnexa are associated with the sigmoid flexure. Both are closely associated with the ureters (Chapter 16).

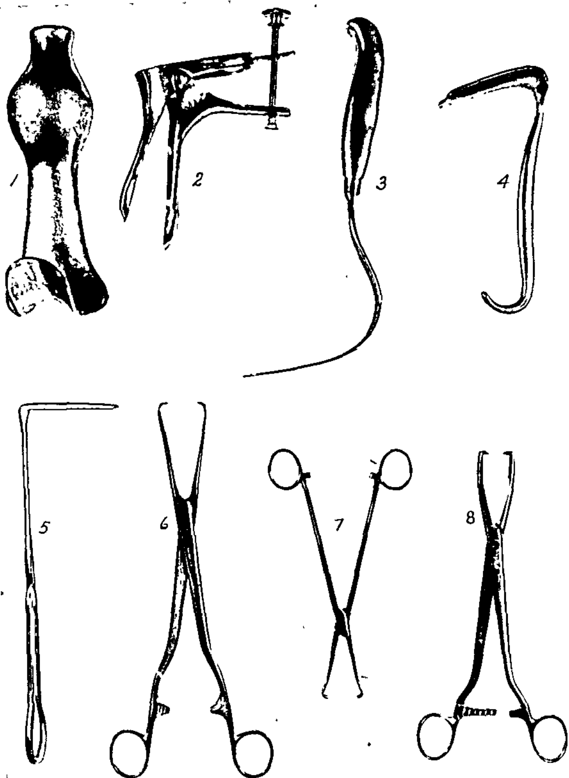
The ovaries consist of a narrow outer layer, called the cortex, and an inner vascular layer, called the medulla. The ovaries are not covered with peritoneum. The cortex contains many cells in which are embedded the follicles containing ova. The medulla consists of connective tissue, nerves, blood, and lymph vessels.

The two fallopian tubes are situated one on each side and provide a channel between the ovaries and the uterus. The fallopian tubes leave the upper portion of the uterus and pass outward toward the sides of the pelvis, ending in fringe-like projections called fimbriae, just below the ovaries. The tubes carry the ova from the ovaries to the uterine cavity. The tubes are covered on their outer surfaces by peritoneum (Figs. 356 and 362).[1,3,11]

Breast.—These accessory sex organs vary in size, usually extending over the chest region. They are bounded medially by the parasternal line and laterally by the anterior fold of the axilla at the level between the seventh and third ribs. The breast consists of loosely connected areolar tissue which is attached to the undermuscles of the chest wall (Chapter 9). Except for the central portion, the breast is covered by normal skin. The nipple, through which the main ducts discharge their contents, is situated on the surface of the breast within the center portion. These mammary glands are supplied with an extensive network of lymphatic vessels and derive their blood supply mainly from the internal mammary artery and from the lateral thoracic and the third to the seventh intercostal arteries. The venous blood flows either into the axillary veins or connects with the deep veins that accompany the arteries.[2, 12-15]

FACILITIES AND SETUPS FOR GYNECOLOGIC SURGERY

The physical facilities of the operating room unit for surgery on the gynecologic patient should meet medical aseptic standards required for general surgery. The construction of the furniture and environmental conditions must meet the safety requirements established for general surgery (Chapters 1, 2, 3, and 4).



F[illegible] l speculum;
2, Br[illegible] 4, Jackson
vagin[illegible] ps; 7, short
vulse[illegible]

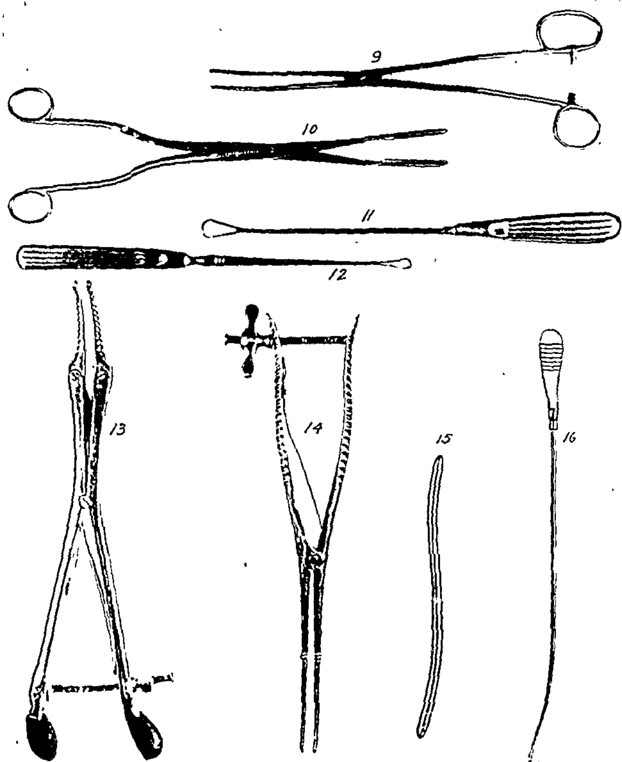


Fig. 301.—Instruments for gynecologic operations—cont'd. *9*, Bozeman uterine dressing forceps; *10*, placenta forceps; *11*, uterine dull curette; *12*, uterine sharp curette; *13*, Goodell uterine dilator; *14*, Wylie uterine dilator; *15*, Hegar uterine dilator; *16*, Sims flexible graduated uterine sound.

The standard setups should enable the surgeon to modify his tentative plan of treatment without interruption during the operation.

Setup for Vaginal Preparation

Sterile Items

1 Irrigating set, including can, tubing, connector, and metal irrigating tip
1 Bozeman dressing forceps (Fig. 361)
1 Urethral catheter No. 14 or 16 F
pHisoHex or soap and water
Germicide
2 Medication cups
8 Sponges, gauze or compressed cotton
4 Sponge-holding forceps
1 Sims vaginal speculum
2 Strips of cotton tape, ½ inch wide, 8 inches long, optional
1 Flask of sterile distilled water at 98° F.
1 Pair gloves, suitable size
2 Towels

Unsterile Items

Mayo stand
Plastic sheet or Kelly pad
Kick-bucket
Infusion stand, if desired
Table appliances for lithotomy position

Sterile Setup for Vaginal Surgery

Textiles and Solutions

1 *Lithotomy pack* consisting of:

- 12 Surgical towels
- 1 Large sheet
- 1 Small sheet
- 1 Portable tray cover
- 1 Lithotomy sheet
- 24 Gauze sponges
- 4 Cotton applicators
- 1 Strip of cotton tape, ½ inch wide, 16 inches long
- 1 Yard gauze packing, optional
- 1 Perineal dressing set

1 Gown pack
1 Glove set
1 Flask normal saline solution
1 Hypodermic syringe
1 Intramuscular needle
2 Ampules of drug used to overcome urinary retention or to stimulate uterine contractures
6 Laparotomy pads
Additional packages of sponges
Infusion set and intravenous solution
Test tubes for urine specimen
Specimen bottle
Lubricating jelly

Instruments and Drains

2 Doyen or Kelly retractors (Fig. 363)
1 Auvard weighted speculum, optional
1 Sims vaginal retractor, suitable width
3 Scalpels, 2 handles No. 4 and 1 No. 3; 2 blades No. 20 and 1 No. 10
3 Tissue forceps with 2 and 3 teeth—2, 5½ inches; 1, 7 inches
1 Bozeman dressing forceps
1 Kelly tissue forceps, 7 inches
3 Tissue forceps without teeth—2, 5½ inches; 1, 7 inches
1 Ferguson scissors, angular, curved on flat, 7 inches
1 Mayo, Sims, or Kelly scissors, curved on flat, 6¾ inches
1 Suture scissors
6 Foerster or Robert sponge-holding forceps, 9½ inches
2 Backhaus towel forceps, 5¼ inches
2 Mayo-Hegar needle holders, 7 inches
2 Kelly-Emmett tenacula (Fig. 363)
1 Jacobs vulsellum forceps with 1 and 2 teeth (Fig. 363)

4 Allis-Adair forceps with 9 and 10 teeth, 6 inches
4 Kocher forceps, 5½ inches
12 Crile hemostats, straight jaws, 6¼ inches
12 Pean hemostats, curved jaws, 6¼ inches
4 Ochsner forceps—2, straight jaws; 2, curved jaws, each 6¼ inches
1 Uterine sound, pliable and graduaated (Fig. 364)
1 Uterine biopsy forceps
1 Urethral catheter No. 14 or 16 F
1 Indwelling catheter, Pezzer No. 14 F and stylet, or Foley No. 16 F with 5 ml. bag (Chapter 16)
1 Asepto syringe, 2 ounces
1 Small metal tray for surgeon

Sutures

2 Mayo ½-circle trocar-point No. 5 or 4 or swaged-on needles on medium chromic surgical gut Nos. 2-0 and 0
2 Martin ½-circle cutting-edge needles No. 6 or 5 or swaged-on needles on medium or extra chromic surgical gut Nos. 2-0 and 0
2 Murphy needles No. 3, ½-circle trocar-point surgeon's cutting-edge No. 10, or swaged-on cutting-edge needles on chromic gut No. 3-0
2 Murphy needles No. 3, ½-circle taper-point, or swaged-on needles on chromic gut or silk Nos. 3-0 and 2-0

Skin sutures, desired type and size

Sterile Setup for Uterine Dilatation

1 Garrigue or Auvard vaginal speculum (Fig. 363)
2 Sims, Kelly, or Doyen anterior and posterior retractors (Fig. 363)
1 Heaney or Ferguson blade retractor, desired size
2 Schroeder, Braun, or Henrotin vulsellum forceps, 1 and 2 teeth, 9½ inches (Fig. 363)
1 Sims uterine sound, flexible, graduated (Fig 364)
1 Wylie uterine dilator, plain smooth blade, 12 inches (Fig. 364)
1 Goodell uterine dilator, large or small size (Fig. 364)
2 Crile hemostats, straight, 6¼ inches
2 Mayo scissors, 1 straight, 1 curved, 6¼ inches
4 Foerster sponge-holding forceps
2 Backhaus towel forceps
1 Uterine packer, optional
1 Set Hegar, Hank, or Kelly dilators (Fig. 364)
3 Sims uterine curettes, sharp, Nos. 1, 2, and 4, 11 inches (Fig. 364)
3 Thomas uterine curettes, blunt, plain, Nos. 1, 3, and 5, 11 inches (for incomplete abortion) (Fig 364)
1 Bozeman uterine forceps (Fig. 364)
1 Pean hemostat, curved, 8 inches
2 Kocher forceps, 5½ inches (optional)
1 Needle holder
1 Suture, chromic gut No. 2-0, and ½-circle trocar-point needle or swaged-on needle
2 Specimen bottles
2 Medication cups
1 Aluminum tray, if desired
1 Kelly placenta forceps (for incomplete abortion)

Also

1 Hypodermic syringe and needle
1 Ampule surgical pituitary extract or other drug, if desired
1 Vaginal pack
1 Minor operating pack
1 Yard gauze packing, plain or iodoform, if desired
1 Set gloves
1 Set gowns
1 Infusion setup and desired intravenous solutions
1 Skin preparation setup

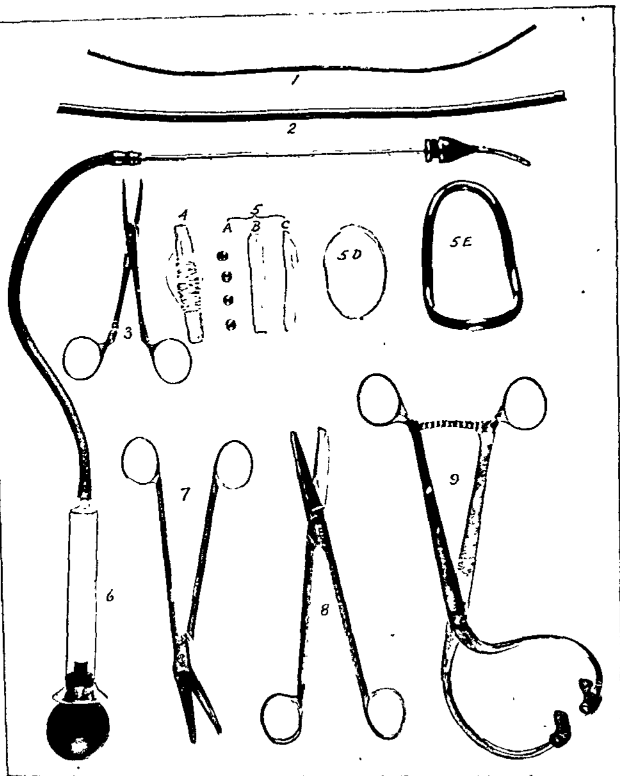


Fig. 365—Instruments for gynecologic operations—cont'd: *1,* Dakin tubing; *2,* black rubber tubing; *3,* short hemostat; *4,* spool linen thread; *5A,* lead shot; *5B,* Baldwin glass stem pessary; *5C,* Baldwin angled glass pessary; *5D,* silver wire; *5E,* retroversion ring pessary; *6,* apparatus for insufflation of fallopian tubes; *7,* Emmett uterine scissors; *8,* Sims uterine scissors; *9,* Collins uterine elevating forceps.

4 Allis-Adair forceps with 9 and 10 teeth, 6 inches
4 Kocher forceps, 5½ inches
12 Crile hemostats, straight jaws, 6¼ inches
12 Pean hemostats, curved jaws, 6¼ inches
4 Ochsner forceps—2, straight jaws; 2, curved jaws, each 6¼ inches
1 Uterine sound, pliable and graduaated (Fig. 364)
1 Uterine biopsy forceps
1 Urethral catheter No. 14 or 16 F
1 Indwelling catheter, Pezzer No. 14 F and stylet, or Foley No. 16 F with 5 ml. bag (Chapter 16)
1 Asepto syringe, 2 ounces
1 Small metal tray for surgeon

Sutures

2 Mayo ½-circle trocar-point No. 5 or 4 or swaged-on needles on medium chromic surgical gut Nos. 2-0 and 0
2 Martin ½-circle cutting-edge needles No. 6 or 5 or swaged-on needles on medium or extra chromic surgical gut Nos. 2-0 and 0
2 Murphy needles No. 3, ½-circle trocar-point surgeon's cutting-edge No. 10, or swaged-on cutting-edge needles on chromic gut No. 3-0
2 Murphy needles No. 3, ½-circle taper-point, or swaged-on needles on chromic gut or silk Nos. 3-0 and 2-0

Skin sutures, desired type and size

Sterile Setup for Uterine Dilatation

1 Garrigue or Auvard vaginal speculum (Fig. 363)
2 Sims, Kelly, or Doyen anterior and posterior retractors (Fig. 363)
1 Heaney or Ferguson blade retractor, desired size
2 Schroeder, Braun, or Henrotin vulsellum forceps, 1 and 2 teeth, 9½ inches (Fig. 363)
1 Sims uterine sound, flexible, graduated (Fig. 364)
1 Wylie uterine dilator, plain smooth blade, 12 inches (Fig. 364)
1 Goodell uterine dilator, large or small size (Fig. 364)
2 Crile hemostats, straight, 6¼ inches
2 Mayo scissors, 1 straight, 1 curved, 6¼ inches
4 Foerster sponge-holding forceps
2 Backhaus towel forceps
1 Uterine packer, optional
1 Set Hegar, Hank, or Kelly dilators (Fig. 364)
3 Sims uterine curettes, sharp, Nos. 1, 2, and 4, 11 inches (Fig. 364)
3 Thomas uterine curettes, blunt, plain, Nos. 1, 3, and 5, 11 inches (for incomplete abortion) (Fig. 364)
1 Bozeman uterine forceps (Fig. 364)
1 Pean hemostat, curved, 8 inches
2 Kocher forceps, 5½ inches (optional)
1 Needle holder
1 Suture, chromic gut No. 2-0, and ½-circle trocar-point needle or swaged-on needle
2 Specimen bottles
2 Medication cups
1 Aluminum tray, if desired
1 Kelly placenta forceps (for incomplete abortion)

Also

1 Hypodermic syringe and needle
1 Ampule surgical pituitary extract or other drug, if desired
1 Vaginal pack
1 Minor operating pack
1 Yard gauze packing, plain or iodoform, if desired
1 Set gloves
1 Set gowns
1 Infusion setup and desired intravenous solutions
1 Skin preparation setup

Sterile Setup for Abdominal Gynecologic Surgery

Textiles and Sutures

Vaginal preparation setup
Vaginal packing, if desired
Urethral catheter, desired type and size
- 1 Glove set (Chapter 2)
- 1 Gown set (Chapter 2)
- 24 Compresses 4 by 4 inches
- 24 Compresses 2 by 2 inches
- 12 Laparotomy pads with rings attached, 6 large and 6 small size
- 1 Major operating pack (Chapter 2)
- 1 Fenestrated sheet
- 1 Flask normal saline solution
- 1 Infusion setup

Basic Instruments

- 2 Roux or Parker retractors (Chapter 11)
- 1 Pliable copper retractor, ½ inch wide, 13 inches
- 1 Balfour or O'Sullivan self-retaining abdominal retractor with interchangeable lateral and center blades, appropriate size, total opening 7 or 8 inches (Chapter 15)
- 2 Mayo-Collins or Murphy blunt retractors
- 2 Richardson retractors, blade 2½ by 2 inches (Chapter 11)
- 1 Deaver retractor, appropriate size, optional
- 3 Scalpels, handles Nos. 4, 3, and 3 L or 4 L
- 3 Blades Nos. 21 or 20, 10 and 15
- 2 Deschamps ligature carriers, right and left, or Barrett carrier, 7 inches
- 2 Pool suction sets; 1 cannula straight, 23 F, 8¾ inches, and 1 angular 23 F; 2 pieces rubber tubing
- 1 Ochsner trocar and cannula, 20 F, 6 inches
- 2 Heaney tissue forceps, 2 and 3 teeth, 5½ inches
- 2 Kelly tissue forceps, 3 and 4 teeth, 9 inches; or Heaney forceps, 7½ inches
- 1 Russian or Mayo forceps, 9 inches
- 1 Kelly tissue forceps, 1 and 2 teeth, 8 inches
- 2 Tissue forceps without teeth—1, 5½ inches; 1, 8 inches
- 1 Suture scissors, straight
- 2 Emmett or Sims uterine scissors, curved on flat, right or left, optional
- 1 Mixter, Boettcher, or Kahn scissors, 7 or 8 inches
- 2 Mayo scissors, curved on flat—1, 6¾ inches; 1, 9 inches
- 1 Mayo-Harrington or Dubois scissors, curved on flat, 11 inches (for Wertheim procedure)
- 3 Mayo-Hegar needle holders with Ochsner jaw—2, 6 inches; 1, 8 inches
- 1 Barrett or Bozeman uterine packing forceps (Fig. 364)
- 8 Foerster or Roberts sponge forceps, 8 inches
- 16 Backhaus towel forceps without stops, 5¼ inches
- 1 Probe, 7 inches
- 1 Grooved director, 6 inches
- 6 Judd-Allis or Allis-Adair forceps, 7½ inches (Chapter 12)
- 8 Pean hysterectomy forceps, 9 or 10 inches—4 straight and 4 curved
- 12 Crile hemostatic forceps, straight, 5¼ inches
- 1 Babcock forceps, optional
- 4 Ochsner forceps, straight, 6¼ inches; or Phaneuf or Heaney hysterectomy forceps, straight and curved, 7½ inches (Fig. 366)
- 1 Collins or Schroeder forceps, 3 and 4 teeth, 9 inches (Fig. 366)
- 1 Schroeder, Henrotin, or Tucker vulsellum forceps, 2 and 3 teeth, curved, 8½ inches (Fig. 366)
- 18 Mayo-Rochester forceps, curved jaws, 6¼ inches (Fig. 366)
- 2 Wertheim-Cullen pedicle clamps, 7½ inches, jaws 2½ inches (for radical procedure)
- 1 Uterine elevating forceps, 9 inches, optional
- 1 Doyen tumor screw, optional
- 2 Jacobs vulsellum forceps, 2 and 3 teeth, straight 8¼ inches (Fig. 366)
- 1 Autoclip applier and autoclips, 18 mm, or 2 Hegenbarth clip-ap-

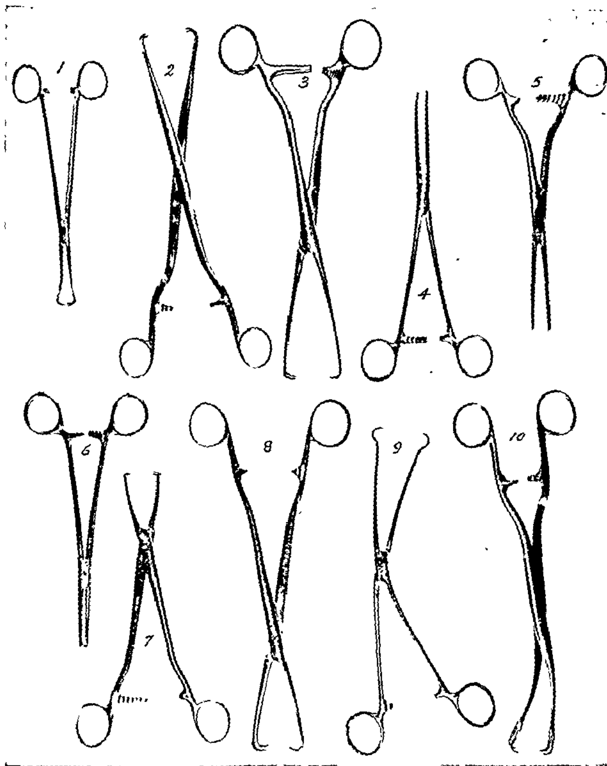


Fig. 366.—Instruments for gynecologic operations—cont'd. *1*, Massachusetts General Hospital vulsellum forceps; *2*, Schroeder straight vulsellum forceps; *3*, Schroeder straight, heavy vulsellum forceps; *4*, Mayo-Carmalt hemostat, 8 inches; *5*, Rochester-Pean hemostat, 8 inches; *6*, Mayo-Ochsner hemostat, 7¼ inches; *7*, Jacobs straight vulsellum forceps; *8*, Wylie 1- and 2-pronged tenaculum forceps; *9*, tenaculum, curved sideways; *10*, Schroeder curved sideways vulsellum forceps.

2. When the electrosurgical unit is to be used, lubricate the inactive electrode and attach the ground cord to it; then test the machine. Leave the machine connected, but turn off the current. Arrange the preparation tray, stools, and kick-bucket in readiness for use. Test the surgical lamp, adjust it in correct position, and turn off the current.

3. Greet the patient by name and introduce self, if she is awake. Check the patient's chart according to the admitting rules. Apply leggings if needed. Take the patient to the operating room unit.

4. Bring stretcher alongside the operating table so that the patient's buttocks are at a level with the edge of the table's lower section. Lock the stretcher and the table; then transfer the patient onto the table. Place the buttocks in correct position eliminates the need of later moving the patient down toward the foot.

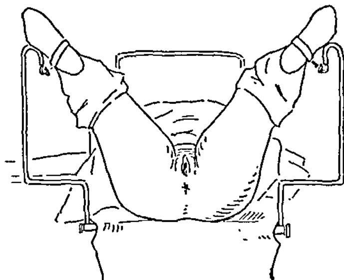


Fig. 367.—The patient is placed on the operating table in a lithotomy position. Note the wide-angled stirrups which prevent pressure on the medial calf. The patient's buttocks are at a level with the table's edge. With the patient in this position, the perineum is prepared. (From Parsons, L., and Ulfelder, H.: An Atlas of Pelvic Operations, Philadelphia, 1953, W. B. Saunders Co)

5. Adjust the thin support beneath the patient's head and shoulders to prevent flexion or contractures of the neck. Support the legs with a folded sheet if the feet protrude beyond the table. Secure the arm on an armrest, if required (Chapter 4).

6. Secure a leg strap around the table and over the thighs. Gently hold the patient's hands until she is asleep.

7. When the patient is completely relaxed, unfasten the leg strap. Adjust the small pillow beneath the lumbar curvature. Slightly abduct the arm or arms, flex the elbows slightly, and bring the hands over the center area of the upper abdomen. Secure the hands and forearms in the gown. Drape a small sheet over the pubic and perineal regions.

8. Attach and adjust the stirrups; internally rotate and raise conventional stirrups to minimize abduction which, in turn, reduces arching of the lumbosacral vertebra (Chapter 4 and Fig. 367).

plying forceps, 5 inches, and Michel clips, sizes 16 or 18 mm.

Drainage Set

Penrose tubing, ⅜ inch wide
Dakin tubing for bumpers
Indwelling catheter (Foley No. 14 or 16 F with 5 ml. bag)
Soft rubber tubing, narrow and medium diameter
Urethral catheter, desired type and size

Sutures

Standard setup sufficient for use in most patients (Chapter 5)

2 Keith straight skin needles or surgeon's ⅜-circle cutting-edge needles threaded to nylon, silk, or fine wire
2 Martin uterine, ½-circle trocar-point, or swaged-on needles Nos. 5 and 6; chromic surgical gut Nos. 2-0, 0, and 1, 27 inches
2 Murphy ½-circle trocar-point circles No. 2 or 3, or 2 Murphy or Ferguson needles ½-circle trocar-point; chromic gut No. 2-0 or 3-0 or silk No. 3-0 or 2-0
2 Intestinal ½-circle No. 1¼ swaged-on needles; chromic gut Nos. 0 and 2-0 and silk No. 3 0
2 Mayo ½-circle taper-point needles Nos. 2 and 3; chromic gut No. 0 and 1 and silk Nos. 2-0 and 0
3 Surgeon's ⅜-circle cutting-edge needles No. 3; nylon No. 2-0

Other Items

Detergent
Germicide
Cardiac arrest setup
Appliances for operating table
Electrosurgical unit, optional

IMMEDIATE PREPARATION OF THE PATIENT FOR VAGINAL SURGERY

When the patient is positioned on the operating table, the members of the team are responsible for carrying out measures to insure the safety and comfort of the patient, and to provide for adequate exposure of the proposed operative site (Chapters 4 and 11).

Positioning the Patient

Equipment.—*The items should include the following:*

Modern operating table of sufficient length
2 Stirrups
2 Shoulder braces with pads
1 Anesthetist's screen
1 Leg strap, explosive-proof rubber material
2 Perineal leggings, optional
2 Sponge-rubber pillows in plastic covers
1 Piece protective sheeting or Kelly pad
1 Strip adhesive tape ½ inch wide, 18 inches long
1 Armrest, if desired

Steps of Procedure.—The circulating nurse should make all preliminary preparations before the patient arrives. The steps of the procedure include the following:

1. Neatly fold back the lower part of the sheet on the operating table; remove the lower table pad or unfasten its tabs. Place a thin supportive pad on the center section of the table, unless contraindicated; cover the leg section with a plastic sheet and a large surgical towel. Drop the headpiece and place a small pillow on the uppermost part of the table. Assemble the stirrups and shoulder braces on a table.

2. When the electrosurgical unit is to be used, lubricate the inactive electrode and attach the ground cord to it; then test the machine. Leave the machine connected, but turn off the current. Arrange the preparation tray, stools, and kick-bucket in readiness for use. Test the surgical lamp, adjust it in correct position, and turn off the current.

3. Greet the patient by name and introduce self, if she is awake. Check the patient's chart according to the admitting rules. Apply leggings if needed. Take the patient to the operating room unit.

4. Bring stretcher alongside the operating table so that the patient's buttocks are at a level with the edge of the table's lower section. Lock the stretcher and the table; then transfer the patient onto the table. Place the buttocks in correct position eliminates the need of later moving the patient down toward the foot.

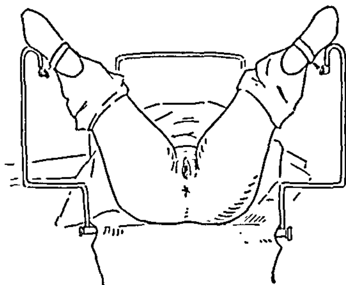


Fig. 367.—The patient is placed on the operating table in a lithotomy position. Note the wide-angled stirrups which prevent pressure on the medial calf. The patient's buttocks are at a level with the table's edge. With the patient in this position, the perineum is prepared. (From Parsons, L., and Ulfelder, H.: An Atlas of Pelvic Operations, Philadelphia, 1953, W. B. Saunders Co.)

5. Adjust the thin support beneath the patient's head and shoulders to prevent flexion or contractures of the neck. Support the legs with a folded sheet if the feet protrude beyond the table. Secure the arm on an armrest, if required (Chapter 4).

6. Secure a leg strap around the table and over the thighs. Gently hold the patient's hands until she is asleep.

7. When the patient is completely relaxed, unfasten the leg strap. Adjust the small pillow beneath the lumbar curvature. Slightly abduct the arm or arms, flex the elbows slightly, and bring the hands over the center area of the upper abdomen. Secure the hands and forearms in the gown. Drape a small sheet over the pubic and perineal regions.

8. Attach and adjust the stirrups; internally rotate and raise conventional stirrups to minimize abduction which, in turn, reduces arching of the lumbosacral vertebra (Chapter 4 and Fig. 367).

9. Stand near the stirrup with back toward the head of the table; grasp the sole of the foot with one hand and support the leg near the knee joint with the other hand; slowly flex the knee; then secure the foot in the holder at a right angle to the leg. Secure one canvas loop around the sole about three inches from the toes and the second one around the heel. Adjust the holder to the length of the leg to reduce pressure on the back of the knee and lumbosacral region.[16, 22] Abduction and outward rotation result in stretching of the abductor muscles and capsule of the hip joint (Chapter 4). A pull on the abductors and stretching of the iliopsoas muscles cause rotation of the pelvis and arching of the back (Chapter 4).

10. If the leg presses against the stirrup, place a sponge-rubber pad between the stirrup and leg at the pressure point. Position the other leg if both legs have not been positioned simultaneously.[17, 18]

11. Remove the lower section of the table pad and lower the end of the table. Make sure that the patient's hips are parallel, the buttocks are level and on the table, and the trunk and head are in straight line. The buttocks must not extend over the table because the edge of the table will act as a fulcrum, which in turn produces more arching of the lumbrosacral region (Chapter 4).

12. Place a kick-bucket at the end of the table and drop the lower end of the protective sheet in the bucket. Place the vaginal preparation setup near the end of the table. Expose the vulva by turning back the sheet. Assist the operator as he cleanses the proposed operative site. (Fig. 367.)

13. Attach the padded shoulder braces to the operating table, making sure that the braces rest about one and one-half inches from the outer aspects of the patient's shoulders (Chapter 4). Tilt the table slightly upward to bring the operative site into view. Attach the anesthetist's screen to the table and adjust the operating lamp.

14. After completion of the skin-cleansing procedure, remove the plastic sheet and place a clean towel under the patient's buttocks; take the preparation setup to the utility room.

15 When a vaginal operation is to be done, hold the ends of an adhesive strip as the scrubbed nurse drapes a sterile towel over it and secure the ends of the tape to the buttocks so that the towel covers the anus. Go to the head of the table and tuck the uppermost ends of the fenestrated sheet under the table pad (Fig 368).

16. When an abdominal operation is to be performed, remove the soiled protective sheeting, raise the lower section of the table, replace the table pad, draw the sheet on the table down over the table pad, and place the patient in a supine position. Remove the stirrups and place the patient in the desired position.

Cleansing Procedure

The operator scrubs his hands and puts on sterile gloves before preparing the patient. The steps of the procedure include the following:

1. Saturate gauze sponges with a detergent or soap and a small amount of sterile water; wash, applying light friction, the labia minora, the labia majora,

and the pubic region to six inches above the symphysis, outward onto each groin, and laterally from the anus.[17, to 21]

2. Wash the anal region and discard used sponges in the kick-bucket; then cleanse the vagina thoroughly, using sponges on holders and a bladed retractor.

3. Irrigate the vagina, using sterile normal saline solution at body temperature or a medicated solution; then wash off the external genitals. The circulating nurse holds the irrigator or secures it to a standard. (Fig. 368.)



Fig 368.—The patient is draped with a fenestrated perineal sheet The footstool and basin combination and adjustable stool are ready for use The used preparation setup is ready to be disassembled.

4. Examine the vagina, perform catheterization, and obtain specimen if requested. The circulating nurse fills in the laboratory form and sends the specimen to the laboratory. Prior to abdominal surgery, the urethral catheter may be left in place and kept open.

5. Insert a vaginal speculum and disinfect the vagina and external genitals, using gauze sponges saturated with an antiseptic solution and secured to sponge-holding forceps.

6. Dry the external genitals and the surrounding region with a sterile towel.

7. If an abdominal operation is to be performed immediately, insert vaginal packing, if desired.

Draping Procedure and Position of the Team

The standard draping procedure should provide a sterile operative field, adequate exposure of the proposed operative site, and conserve materials and human resources (Chapter 4).[8, 17, 21, 22]

To drape the patient for a vaginal operation, the steps of the procedure include the following:

1. Place a sterile towel or folded sheet over the pubic region. Place a second towel over the anus, using adhesive tape, or secure it with sutures.

2. Place a sterile fenestrated sheet over the patient as follows: Hold the fanned sheet in front of the operative site. Unfold one-half of the sheet with legging, grasp its uppermost end with one hand, turn the sheet over the gloved hand to form a protective cuff, and slip on the legging, holding the other folded legging in the other hand, or allow an assistant to hold it.

3. Keeping the center portion of the sheet over the cleansed site, unfold the other legging and slip it over the other leg and thigh. Arrange the sheet over the cleansed area so that the proposed incisional site is exposed.

4. Drape a fan-folded sheet over the pubic and lower abdominal region when the perineal sheet is not made of two thicknesses of muslin, or when the patient's chest and the anesthetist's screen are exposed.

Position of the Operating Team.—The surgeon sits on a stool placed in front of the operative site. A small sterile tray for instruments and sponges may be placed on his lap. The assistant operator stands at the left of the operator. The Mayo (portable) stand with the sterile instruments and other items is placed to the left of the operator, and the scrubbed nurse stands behind it. The instrument table is positioned near the scrubbed nurse, allowing sufficient space for her to move without danger of contaminating the sterile field (Chapter 4).

PREPARATION OF THE PATIENT FOR ABDOMINAL SURGERY

The standard procedure to be carried out when positioning the patient (Chapter 4), cleansing the proposed operative site (Chapter 3), and draping the patient (Chapter 4) must provide safety and comfort to the patient, conserve human and material resources, and assist, not hamper, the surgeon as he performs the operation.[5, 7, 17, 20, 21]

Positioning the Patient in a Trendelenburg Position

To perform abdominal surgery on the reproductive organs, the patient is generally placed in a Trendelenburg position (Chapter 4).

Equipment.—The items should include the following:

1 Modern operating table with sectional pads made of sponge rubber and covered with removable explosion-proof rubberized material
2 Metal shoulder braces with sponge-rubber pads covered with explosion-proof rubberized material
1 Leg restraint strap made of explosion-proof rubberized material
1 Lift sheet
1 Anesthetist's screen
1 Armrest with restraints
1 Small thin pillow
1 Sheet to cover the patient
2 Leggings, if requested
Stirrups for lithotomy position

Steps of Procedure.—The circulating nurse should carry out the steps as follows:

1. Assemble all items in the room before the arrival of the patient; place the operating table in the hall near the operating room unit.

2. Greet the patient by name, if she is awake, check the patient's chart, and assist in placing her on the operating table in a supine position with the knees over the lower break of the table (Chapter 4).

3. Place a small thin pillow under the patient's head and shoulder to prevent flexion and contractures of the neck and head. Fasten leg strap around table usually above the knees, making sure it will not inhibit circulatory functioning.

4. Take the patient into the operating unit. Gently hold the patient's hands until she is asleep. Secure one arm to the armrest, if desired (Chapter 4).

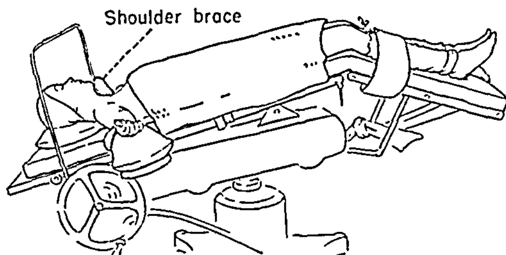


Fig. 369.—The patient is placed on the operating table in a Trendelenburg position The degree of depression of the upper part of the table should allow the intestines to fall back out of the pelvis with the minimal amount of packing. The popliteal space of each leg is resting at the level of the lower break of the table. The feet may be secured, as shown, with a long, wide-tailed cotton strap which passes around the ankle to fix to the crossbar beneath the foot of *the table*. *This* permits less strain on the shoulder brace and minimizes the danger of brachial stretching and subsequent paralysis. The body is kept in good alignment and spinal curvatures supported unless contraindicated. The lower portion of the table is broken at the level of the popliteal space, which may be supported by a small sponge-rubber pad. (From Parsons, L., and Ulfelder, H: An Atlas of Pelvic Operations, Philadelphia, 1953, W. B. Saunders Co)

5. Adjust the lift sheet, making sure it lies flat beneath the middle and lower regions of the back. Place a small pillow beneath the lumbosacral region, if not contraindicated.

6. Place the legs about three inches apart, with the feet at right angles to the legs to provide for proper muscle balance and circulation. Support the feet with an oblong thin pad to prevent the toes from dropping downward (Fig. 369).

7. To provide for absorption of the patient's weight and help stabilize the patient, attach a padded shoulder brace to each side of the table and about one and one-half inches from the outer aspects of the shoulder, thereby preventing pressure on the brachial plexus (Chapter 4). Attach the anesthetist's screen.

8. To allow the viscera to gravitate toward the upper abdomen, thereby permitting better exposure of the operative site, tilt the upper sections of the operating table downward toward the head at about 30 to 40 degrees.

Draping Procedure and Position of the Team

The standard draping procedure should provide a sterile operative field, adequate exposure of the proposed operative site, and conserve materials and human resources (Chapter 4).[8, 17, 21, 22]

To drape the patient for a vaginal operation, the steps of the procedure include *the following:*

1. Place a sterile towel or folded sheet over the pubic region. Place a second towel over the anus, using adhesive tape, or secure it with sutures.
2. Place a sterile fenestrated sheet over the patient as follows: Hold the fanned sheet in front of the operative site. Unfold one-half of the sheet with legging, grasp its uppermost end with one hand, turn the sheet over the gloved hand to form a protective cuff, and slip on the legging, holding the other folded legging in the other hand, or allow an assistant to hold it.
3. Keeping the center portion of the sheet over the cleansed site, unfold the other legging and slip it over the other leg and thigh. Arrange the sheet over the cleansed area so that the proposed incisional site is exposed.
4. Drape a fan-folded sheet over the pubic and lower abdominal region when the perineal sheet is not made of two thicknesses of muslin, or when the patient's chest and the anesthetist's screen are exposed.

Position of the Operating Team.—The surgeon sits on a stool placed in front of the operative site. A small sterile tray for instruments and sponges may be placed on his lap. The assistant operator stands at the left of the operator. The Mayo (portable) stand with the sterile instruments and other items is placed to the left of the operator, and the scrubbed nurse stands behind it. The instrument table is positioned near the scrubbed nurse, allowing sufficient space for her to move without danger of contaminating the sterile field (Chapter 4).

PREPARATION OF THE PATIENT FOR ABDOMINAL SURGERY

The standard procedure to be carried out when positioning the patient (Chapter 4), cleansing the proposed operative site (Chapter 3), and draping the patient (Chapter 4) must provide safety and comfort to the patient, conserve human and material resources, and assist, not hamper, the surgeon as he performs the operation.[5, 7, 17, 20, 21]

Positioning the Patient in a Trendelenburg Position

To perform abdominal surgery on the reproductive organs, the patient is generally placed in a Trendelenburg position (Chapter 4).

Equipment.—The items should include the following:

1 Modern operating table with sectional pads made of sponge rubber and covered with removable explosion-proof rubberized material
2 Metal shoulder braces with sponge-rubber pads covered with explosion-proof rubberized material
1 Leg restraint strap made of explosion-proof rubberized material
1 Lift sheet
1 Anesthetist's screen
1 Armrest with restraints
1 Small thin pillow
1 Sheet to cover the patient
2 Leggings, if requested
Stirrups for lithotomy position

GENERAL MEASURES

The aim of gynecologic surgery is to restore completely, if possible, the anatomic and functional integrity of the patient. The nursing team can do much to eliminate faulty technical errors and to give the patient and surgeon the reassurance they need at this time (Chapters 4 and 11).

The operating teams should be prepared to adjust their duties to meet the needs of the "emergency" patient. Patients with a diagnosis of a ruptured ectopic pregnancy, corpus luteum hemorrhage, bleeding due to varicosities, torsion of pedicles of the adnexa, ovarian or uterine tumor, or a rupture of an ovarian cyst or encapsulated peritoneal abscess usually require immediate surgery.

The standard nursing procedures should be well defined in the procedure book. However, the skillful nurse with judgment adapts each procedure to meet the individual patient's needs and the surgeon's preferences. Methods which provide a clean, safe environment and control infection have been described and illustrated in Chapters 1 and 2. Suturing techniques have been discussed and illustrated in Chapter 5.

Because the arteries in the female genital organs are accompanied by venous plexuses rather than by single veins, hemostasis is accomplished by inserting sutures and applying reliable clamps with long and short jaws. Long curved clamps are needed to control bleeding from tissues situated deep in the pelvis, and their shape should permit them to be placed perpendicular to the longitudinal direction of the cut tissue. A Deschamps aneurysm needle is frequently used to ligate a pedicle or artery. An effective hemostatic liquid or oxidized cellulose may be applied to control bleeding from a vessel. In cases of severe uterine bleeding, a drug may be injected or the uterus packed with gauze packing impregnated with an antiseptic or antibiotic solution.

Drains may be needed to permit contaminated or sterile secretions to drain outward; however, they are not routinely used in abdominal surgery. A drainage tube, if used, should fit the opening, have the proper wall thickness, and be in good condition. The tube should have only one side opening, since several openings at different levels do not promote drainage, but hinder it. The abdominal cavity is not drained through the original wound but through a special small lateral wound opening made in the abdominal wall. Factors associated with primary wound healing are mentioned in Chapter 5.

Indwelling catheter is generally introduced into the bladder after a plastic operation, especially following a repair of the bladder or urethra (Chapter 16). A soft rubber catheter should be used to empty the bladder because a stiff catheter may damage the narrow or displaced urethra.

The abdominal wound is closed in layers and protected with gauze compresses or similar material, which is then secured with strips of adhesive or other perforated material. A scultetus binder may be used to give additional support. Novak has found that placing a thin sheet of aluminum or pasteboard between the two layers of the binder helps to reduce pain that is caused by violent motions of the abdomen [7, 26] Following a vaginal operation, the sterile gauze dressing is held in place with a T-binder.

9. *To relieve strain on the abdominal muscles and keep the bony pelvic structures in correct alignment,* slightly flex the foot and leg section at about 20 degrees. Adjust the height of the table to suit the operator. Take the uppermost end of the sheet over the patient and fold it back onto the pubic region. Fold the bottom of the patient's gown upward over the chest region, or remove the gown (Chapter 4).

10. Focus the operating lamp over the proposed operative site. Place a small portable stand over the patient's upper chest region to absorb any external pressure that may be exerted by the assistant operator.

Skin Cleansing Procedure

The routine skin-cleansing is carried out (Chapter 3). The area to be disinfected will depend upon the type and location of the incision to be made. The skin area usually includes the upper chest region to the level of the nipples, the abdomen, the pubic region, and the upper region of the thighs (Chapter 3).

Draping Procedure and Arrangement of Equipment

To ensure asepsis, the draper handles the sterile towels and sheet carefully and skillfully (Chapter 4). Four towels are placed on the cleansed skin, leaving an exposed area where the incision is to be made (Figs. 12 to 15, Chapter 3). A fan-folded fenestrated sheet is draped over the patient (Figs. 89 to 91, Chapter 4).

The draped portable stand with sterile instruments is placed over the patient, near the foot of the operating table. A small metal tray to hold the dissecting instruments is placed on the operative field. A basin to hold the soiled sponges is placed on the field in front of the portable stand. The sterile suction tubing is secured to the sterile sheet with a forceps and the free end of the tube is allowed to fall below the sterile field The circulating nurse grasps the free end of the tubing and connects it to the suction set, then turns on the pressure. The instrument table is placed near the foot of the operating table. The scrubbed nurse stands near the portable stand, usually on the side opposite that of the surgeon.

The circulating nurse grasps the legs of the arm basins containing sterile saline solution, and moves them near the operators, then arranges the kick-buckets and foot stools near the operators, pours sterile warm solutions, records the time the operation started, keeps the sponge count, takes care of the specimens, and assists the anesthetist and other members of the operating team in caring for the patient (Chapter 4).

INCISIONS FOR ABDOMINAL GYNECOLOGIC SURGERY

In most cases a median incision is made between the umbilicus and the symphysis pubis (Chapter 11) When it is necessary to extend the incision upward, it is made on the left side of the umbilicus to avoid injury to the ligamentum teres [5,17,19,23-25] A paramedian incision may be made.[26-28] For cosmetic reasons a transverse or curved incision (Pfannenstiel) may be preferred (Chapter 11).

Considerations.—In the presence of an infected lesion, or in elderly and poor-risk patients, a radical vulvectomy may be performed in two or more stages. The vulvectomy may be done first and the lymphadenectomy done two or three weeks later.[8, 19, 23, 25]

Setup, Position, Skin Preparation, and Draping Procedure.—

For Vulvectomy.—As described for vaginal surgery; additional instruments include the following:

12 Crile or Kelly hemostats, curved
6 Mayo-Pean hemostats, curved
6 Allis-Adair forceps
1 Scalpel handle No. 4 with blade No. 21
2 Scissors, angular blades right and left

For Lymphadenectomy.—As described for hernial repair (Chapter 11), adding the following:

1 Scalpel, long handle
8 Towel forceps
2 Russian tissue forceps, 7 inches
1 Harrington scissors
2 Richardson or Deaver retractors
10 Crile or Kelly hemostats, curved
4 Mayo-Pean hemostats, curved
4 Allis-Adair forceps
3 Babcock forceps, long
1 Gown set } for bilateral procedure
1 Glove set } for bilateral procedure
6 Laparotomy pads, medium size

For the vulvectomy, the patient is placed on the operating table in a lithotomy position (Fig. 367). The proposed operative site is cleansed (Chapter 3) and the patient draped with a fenestrated perineal sheet (Fig. 368).

For the lymphadenectomy, the patient is placed on the operating table in a supine position (Chapter 4). Routine abdominal skin preparation and draping procedure for celiotomy are carried out (Chapter 11). A transverse oblique approach is generally used (Chapter 11).

Operative Procedure. — The major steps of the operation include the following:

1. The steps of a radical vulvectomy and the items used are similar to those mentioned for simple vulvectomy, except the incisions are carried down to the deep fascia and the subcutaneous tissues are completely removed with the skin.[4, 5, 20, 21, 26]

2. For lymphadectomy: Through an inguinal incision the subcutaneous and the femoral inguinal and subinguinal glands are removed from the fascial layers along the femoral vessels; the lymph nodes are removed by sharp and blunt dissection. All lymph nodes overlying the external oblique muscles are removed with the femoral lymph nodes and fatty tissues. If the patient's physical condition is satisfactory, an extraperitoneal iliac lymphadenectomy is performed. The inguinal canal is reconstructed.[26]

Anterior and Posterior Colporrhaphy and Perineorrhaphy (Colpoperineoplasty)

Definition.—Reconstruction of the vaginal walls, the components of the pelvic floor, supporting structures of the rectum, and the perineum (Figs. 357, 358, 360).

VAGINAL OPERATIONS

Simple Vulvectomy

Definition.—Excision and removal of the diseased labia majora and labia minora.

Purpose.—To treat advanced kraurosis, leukoplakia vulvae, or persistent intractible pruritus which may be associated with a patchy overgrowth of squamous epithelium.[5, 10, 11, 26]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery. In some cases an electrosurgical unit may be used. General nursing principles that are applied in positioning patients for surgery and the standardization of procedures are discussed in Chapter 4.[20, 28] Preoperative skin preparation and suture materials are discussed in Chapters 3 and 5, respectively.

Operative Procedure.—

Steps	*Items*
1. An outer elliptical incision is made outside the entire diseased skin area and through the subcutaneous fat, including within its boundaries the labia minora, the clitoris, and the medial aspects of the labia majora.	1. Scalpel, electrosurgical knife, sponges, vaginal retractors, Allis-Adair forceps, Crile hemostats, ligatures, chromic or plain surgical gut Nos. 2-0 and 3-0, scissors
2. A second incision is made on the inner side of the labia minora, just external to the urethral meatus.	2. Allis-Adair or Allis-Judd forceps, sponges, scalpel, tissue forceps with teeth
3. The two incisions are made to meet by sharp dissection; the bleeding vessels are clamped and ligated or controlled by electrocoagulation, and the diseased tissue is excised.	3. Scalpel, Russian forceps, Mayo or Sims curved scissors, sponges, Ochsner clamp, Rochester-Pean hemostats, fine-gauged ligatures, sponges on holders, dissection scissors
4. The subcutaneous tissue of the upper incisional wounds is approximated. Remaining outer incisional wounds are sutured to margins of the inner incisional wound. Drainage of the bladder may be established, wound dressings and a binder are applied.	4. Interrupted sutures, chromic gut Nos. 3-0 and 0 or silk No. 3-0 swaged-on ½-circle trocar-point and ⅜-circle cutting-edge needles; Pezzer or Foley catheter No. 14 or 16 F, gauze compresses, and vaginal T-binder, safety pin
5. A catheter may be inserted into the bladder, gauze dressings are applied and held in place with a T-binder.	5. Foley or Pezzer catheter No. 14 or 16 F, gauze compresses, binder, and safety pin

Radical Vulvectomy and Lymphadenectomy
(Taussig's Modification of Bassett's Operation)

Definition.—Removal of the vulva and the regional lymph nodes, including the inguinal femoral and iliac nodes.

the patient is conscious of a bulging or protruding mass in the vaginal region and has a desire to urinate.[4, 22]

The term *rectocele* refers to a herniation of the posterior vaginal wall (anterior rectal wall into the vaginal outlet). This lesion results from failure to repair perineal lacerations and from stretching of the fascial and muscular structures that support the rectum (Fig. 370). In the presence of a large rectocele, the patient is conscious of a bearing down and loss of support, and suffers from constipation, fatigue, and general pelvic discomfort.[20, 22]

The term *enterocele* refers to a herniation of the cul-de-sac of Douglas (lowermost portion of the peritoneal cavity), which protrudes downward between the attenuated anterior rectal and posterior vaginal walls.[7, 20, 26]

Extensive lesions that result in urinary incontinence and uterine prolapse may be corrected by one of several operations, depending upon the extent and type of the pathologic condition and the general physical condition of the patient. In some cases a Kelly or Marshall operation, which is mentioned later in this chapter, may be performed.[26]

Purpose.—A colpoperineoplasty operation is employed to treat simple prolapse of the anterior and posterior vaginal wall and associated lesions that do not involve important changes in the characteristics of the uterus.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery. The setup should include the basic vaginal setup, a dilatation setup, and additional instruments as follows:

1 Gelpi or O'Sullivan-O'Connor vaginal retractor, self-retaining
1 Russian or Mayo tissue forceps with teeth, 7 inches
2 Heaney forceps with 3 and 1 teeth, 7 inches
1 Ferguson or Emmett scissors with angular blades, 7 inches
6 Adair-Allis forceps
4 Phaneuf vaginal forceps, straight, 8½ inches, optional
2 Ochsner or Kocher forceps
1 Electrosurgical unit, cords and electrodes

Sutures

4 Mayo trocar-point—2, No. 4; 2, No. 5
2 Murphy trocar-point No. 3
2 Ferguson taper-point No. 3
2 Surgeon's ½-circle cutting-edge No. 10
Chromic gut Nos. 0, 2-0, 3-0, and 4-0
Silk Nos. 3-0 and 4-0

Drains

1 Foley catheter No. 14 or 16 F, with 5 ml. bag, or Pezzer No. 16 or 18 F
1 Urethral catheter No. 14 or 16 F

Also

Celiotomy setup ready for emergency use

The patient is placed on the operating table in a lithotomy position and prepared as described previously (Figs 367 and 368). The workers apply the principles of body alignment and muscle balance as they position the patient (Chapter 4).

Operative Procedure.—The major steps of anterior and posterior colporrhaphy and perineorrhaphy are illustrated (Figs. 371 to 388), and the items used to perform each step are listed.

Considerations.—During parturition, the outer fibrous layer of the vagina may be torn, thereby permitting the adjoining viscera to herniate into the vaginal outlet.[12, 27, 28] Due to unrepaired perineal lacerations, gradual pulling apart of the underlying fascia, and muscle structures of the pelvic floor and outlet, the woman has symptoms of relaxation and displacement of the pelvic organs.[3, 6, 10, 20, 26]

Accidents, gradual deterioration of the tissues, strain of daily living, or congenital weakness may result in mechanical disturbances of the pelvic structures (Fig. 361).

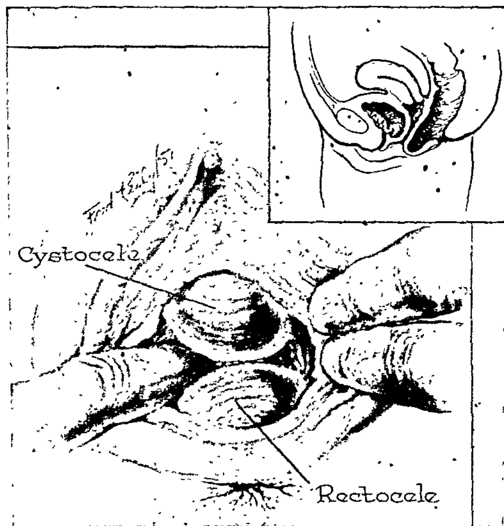


Fig 370—Cystocele and rectocele resulting from unprepared tears of the muscles of the pelvic floor and those under the bladder Usually following the birth of several infants (From Crossen, R. J · Diseases of Women, St Louis, 1953, The C V Mosby Co)

The term *cystocele*, with or without urinary incontinence, refers to a herniation of the bladder through the vaginal anterior wall with protrusion into the vaginal outlet[4, 5, 7, 20] The protrusion results from tearing and overstretching and eventually separation of the fascial and muscular structures that support the bladder (Fig. 370). The symptoms associated with a cystocele depend upon the size of the lesion and the presence of other pathologic conditions. In general,

Fig. 371.



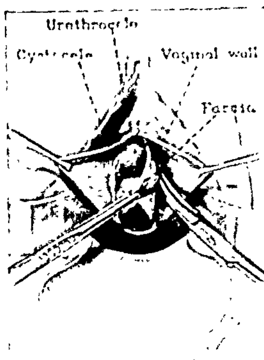
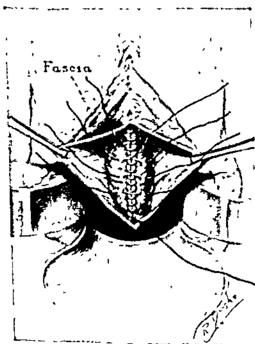


Fig. 372.

Fig. 371.—Correction of cystourethrocele. The cervix is pulled down as far as possible with a tenaculum. A vertical incision is made entirely through to the vaginal wall. (From Counseller, V. S.: Repair of Cysto urethrocele, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.)

Fig. 372.—The vaginal flaps are further dissected upward. The urethral meatus and the pubocervical fascia are separated from the vaginal wall with Mayo scissors. (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher)

Fig. 373



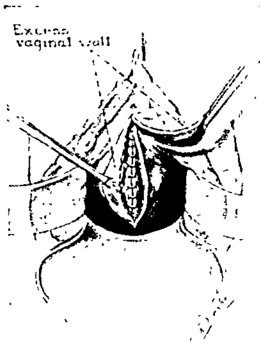
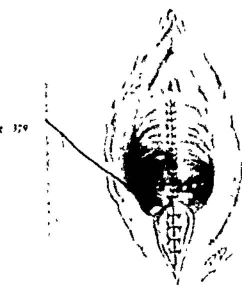


Fig. 374

Fig. 373.—The fascia is brought together with a continuous surgical chromic suture, beginning at the lowest point and ending near the external urethral meatus. A few interrupted sutures (chromic gut or silk) are placed secondarily (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig. 374.—The excess portion of the vaginal wall is carefully removed, leaving a sufficient amount to be closed with tension. (From Counseller, V S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Steps	*Items*
1. The labia are retracted and the anus is walled off just below the mucocutaneous border. The posterior wall and vulvar margins are grasped.[20]	1. Traction sutures of surgical gut No. 0 threaded on ½-circle cutting-edge needles, needle holders, Crile hemostats, self-retaining retractor, small surgical towel or gauze pad, Allis or Adair forceps, vulsellum forceps
2. (a) The mucocutaneous junction is incised from the hymenial remnant on either side.	2. (a) Allis-Adair and Allis forceps, curved scissors, scalpel, sponges, Crile and Mayo-Pean hemostats, Kelly hemostats, ligatures—chromic gut No. 3-0
(b) Through a vertical or transverse incision the vaginal mucosa is incised (Figs. 371, 372).	(b) Scalpel, tissue forceps with teeth, Crile or Kelly hemostats, ligatures and sutures—chromic gut No. 2-0, scissors, sponges
(c) The mucous membrane is dissected lateralward, thus exposing the anterior rectal wall and the medial borders of the levator ani muscles (Figs. 372, 373). In repairing a rectocele the vaginal mucosa is widely separated laterally from the rectum, and the redundant mucosa is resected (Fig. 376). In repairing an enterocele the peritoneum is opened, the uterosacral ligaments are brought together and held by sutures. The peritoneal sac is transfixed and amputated (Figs. 381 to 386).	(c) Allis forceps, Mayo and Emmett scissors, Mayo-Pean and Kocher hemostats, chromic gut No. 2-0 or 3-0 and Murphy or Mayo trocar-point needles, needle holders, Russian tissue forceps; interrupted chromic gut No. 2-0 and Mayo taper-point needles, interrupted chromic gut No. 3-0 and Ferguson needles, needle holders, scissors, sponges
(d) The excess mucous membrane is excised and the levator ani muscles held in proper position with sutures (Figs. 378 to 380).	(d) Skin towels removed, tissue forceps, sponge, hemostats, Allis-Adair forceps, Ochsner, Heaney, and Mayo-Pean hemostats, interrupted sutures, chromic gut Nos. 2-0 and 3-0 and Mayo and Murphy needles, needle holders, scissors
3. The cut edges of the mucous membrane are approximated to form a proper vaginal orifice and tube (Figs. 387, 388).	3. Interrupted sutures chromic gut No. 3-0, 4-0, or 5-0 and swaged-on needles, hemostats, sponges, needle holders
4. Vaginal packing may be inserted, and a catheter introduced into the bladder. The wound is cleansed and dressed.	4. Iodoform packing, ½ inch wide, dressing forceps, Foley or Pezzer catheter, gauze dressings, and binder



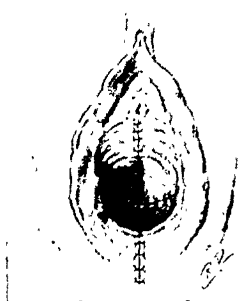
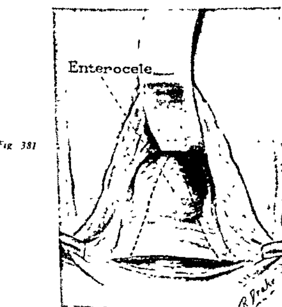


Fig. 379.—The perineum has been restored and Colles' fascia has been repaired with interrupted sutures (From Counseller, V. S, in Lowrie: Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

Fig 380.—The skin of the perineum is closed (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)



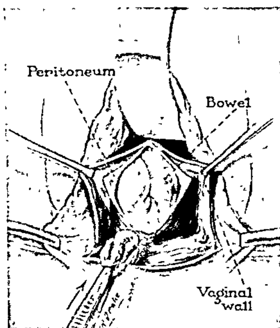
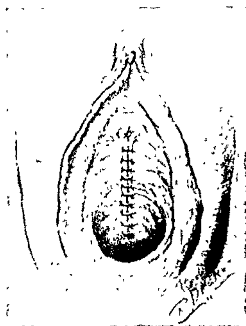


Fig 381.—Exposure of the enterocele (From Counseller, V. S, in Lowrie Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

Fig 382.—Repair of the enterocele The sac is opened (From Counseller, V. S, in Lowrie: Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

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Fig

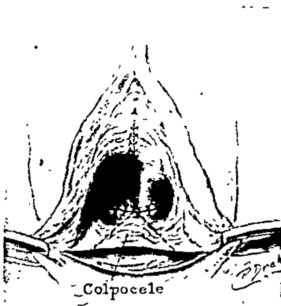


Fig 375—The completed operation, maintaining the bladder urethra in normal position (From Counseller, V. S, in Lowrie Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig. 376—Repair of rectocele. Exposure of the perineum and that portion of the posterior vaginal wall is excised (From Counseller, V. S, in Lowrie. Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

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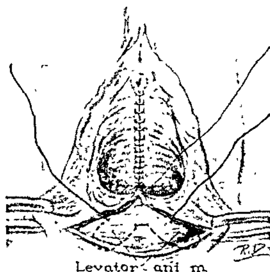


Fig 3

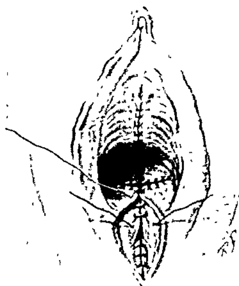


Fig 377—Repair of rectocele The excess skin and excess portion of the posterior vaginal wall have been excised up to the vaginal vault First suture is placed in the vaginal vault. (From Counseller, V S, in Lowrie Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig 378—Levator ani muscles have been brought together with interrupted stitches; Colles' fascia is brought together over the perineum (From Counseller V. S, in Lowrie· Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

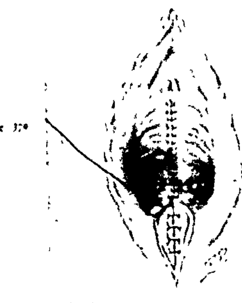
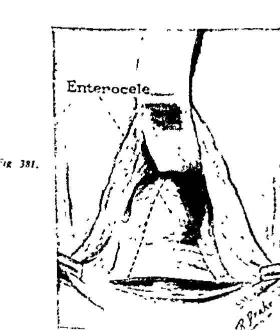




Fig 379.—The perineum has been restored and Colles' fascia has been repaired with interrupted sutures (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher)

Fig 380—The skin of the perineum is closed (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)



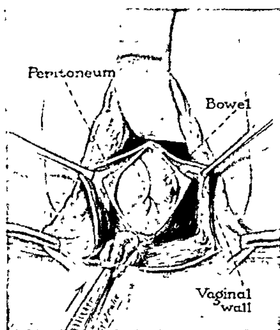
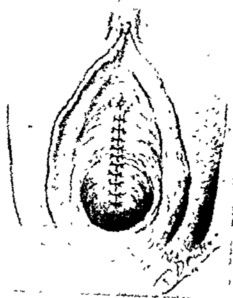


Fig 381.—Exposure of the enterocele (From Counseller, V S, in Lowrie Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig 382—Repair of the enterocele The sac is opened. (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

Fig 375



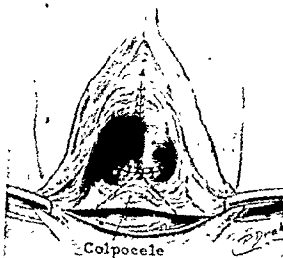


Fig 375 —The completed operation, maintaining the bladder urethra in normal position. (From Counseller, V S, in Lowrie Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig 376 —Repair of rectocele Exposure of the perineum and that portion of the posterior vaginal wall is excised (From Counseller, V. S, in Lowrie Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig 377.

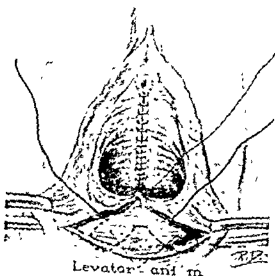




Fig 3

Fig 377 —Repair of rectocele The excess skin and excess portion of the posterior vaginal wall have been excised up to the vaginal vault First suture is placed in the vaginal vault (From Counseller, V S in Lowrie Gynecology Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher)

Fig 378 —Levator ani muscles have been brought together with interrupted stitches; Colles' fascia is brought together over the perineum (From Counseller, V S, in Lowrie Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

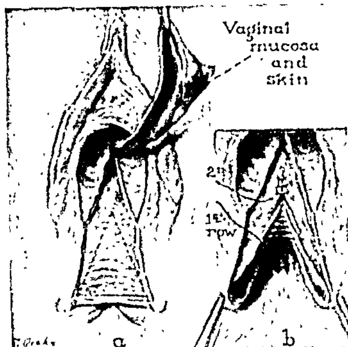


Fig. 387.—Repair of complete lacerations of the perineum. *a*, Lower margins of the incision. *b*, Placement of first and second rows of sutures. (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher)

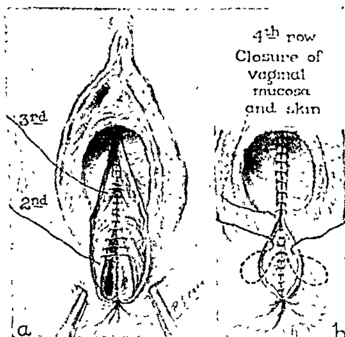


Fig. 388.—Repair of complete lacerations of the perineum. *a*, Second and third rows of sutures. *b*, Fourth row of sutures (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.)

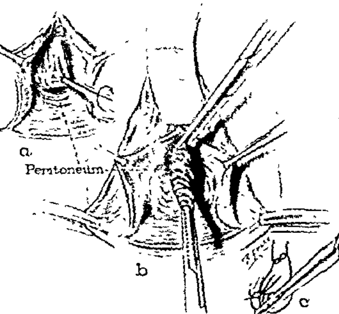


Fig 383

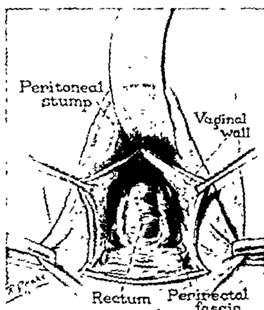


Fig 384.

Fig. 383.—Repair of enterocele *a*, Dissection of the sac; *b*, length of sac; *c*, stick tie placed around the stump. (From Counseller, V. S., in Lowrie. Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Fig. 384.—Repair of enterocele, showing the various structures involved. (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.)

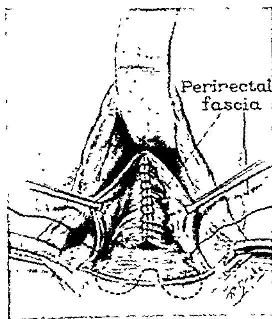


Fig 385

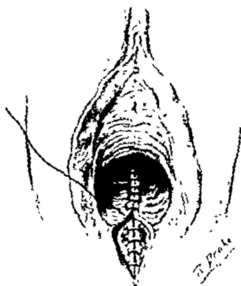


Fig 386

Fig. 385.—Repair of enterocele—cont'd. Placement of sutures (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

Fig. 386.—Repair of enterocele completed. (From Counseller, V. S, in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

bladder is freed further, and the peritoneum is closed. The vagina is separated and the scars of the bladder and vagina are excised. The vaginal opening is closed with chromic gut No. 1 interrupted sutures; then the bladder is closed. A Pezzer catheter is inserted and sutured into the final small openings in the dome of the bladder. Drains may be inserted in the wound, which is closed in layers with interrupted chromic gut sutures.

Repair of Rectovaginal Fistula

Definition.—Repair of third degree perineal tears and fascial and muscle-supporting structures between the rectum and vagina.[29, 30]

Considerations.—A rectovaginal fistula generally results from childbirth or from other trauma, including carcinoma and infection. The patient suffers from fecal incontinence and/or inability to control the passage of gas.

Purpose.—To close the opening formed between the rectum and the vagina.

Setup, Position, Skin Preparation, and Draping Procedure.—As for vesico-vaginal fistula via vaginal outlet.

Operative Procedure.—The steps of a rectovaginal operation are similar to those described for repair of a vesicovaginal fistula (Fig. 389).

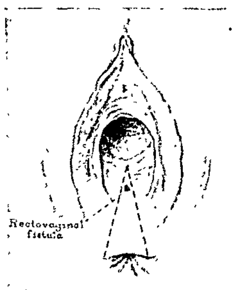


Fig 389.—Repair of rectovaginal fistulas of all types is essentially the same as shown here. Rectovaginal fistula; the portion of scar tissue to be excised is included in the dotted line, and the repair is as for complete lacerations of perineum (Figs. 387 and 388) (From Counseller, V S, in Lowrie Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

Vesicovaginal Interposition of the Uterus
(Watkins-Wertheim Method)

Definition.—Through the vaginal outlet, the vesicouterine folds are sutured to the posterior wall of the uterus, and it is positioned between the bladder and the anterior vaginal wall.

Repair of Vesicovaginal Fistula

Vaginal Approach

Definition.—Through the vaginal outlet the mucosal tissue of the anterior vaginal wall is dissected free, the opening from the bladder into the vagina is closed, the fascial attachments between the bladder and vagina are repaired, and temporary drainage is established.

Considerations.—The fistulae vary in size from a small opening that permits only slight leakage of urine into the vagina to a large opening that permits all the urine to pass into the vagina.

This lesion results from injuries during childbirth or from chronic ulceration involving the anterior vaginal wall or the base of the bladder wall.[6, 10, 17]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery, adding the following to the setup:

1 Mayo-Harrington, Kelly fistula, or Ferguson scissors
2 Kelly tissue forceps, 9 inches
1 Russian or Adson dressing forceps, 7⅛ inches
1 Mayo ureteral knife or scalpel-handle 3 L with blade No. 10
2 Probes, pliable, 6 and 7 inches
1 Antrum curette, small size, 8 inches
1 Frazier or Sachs suction tube 12 or 14 F
1 Heaney-Simon retractor blade, 1 inch wide by 4½ inches, shaft 10½ inches
2 Hooks, blunt
1 Ferguson vesical retractor
1 Asepto syringe, 2 ounces
Electrosurgical unit and attachments, if desired
Sterile petrolatum gauze packing
Catheters, desired type and size—Robinson No. 12, 14, or 16 F, or Foley No. 16 or 14 F with 5 ml. bag

Operative Procedure.—

1 The vaginal mucous membrane is trimmed away from the vaginal wall and the vaginal wall dissected from the bladder. The vaginal wall and fascial layers are separated from the fistula by sharp and blunt dissection.

2. The opening in the bladder is closed in layers with chromic gut sutures Nos. 0 and 3-0.

3 The vaginal mucosa and fascial layers are approximated over the defect with wire steel No. 5-0, silk No. 2-0, or chromic surgical gut Nos. 2-0 and 3-0 swaged-on needles or threaded on Murphy needles

4. The bladder is distended with distilled sterile water to determine any leaks, and a catheter is introduced into the bladder.

Suprapubic Extraperitoneal Approach

A suprapubic setup is needed (Chapter 16) The patient is placed on the operating table in a Trendelenburg position as described previously in this chapter. Urethral catheters are introduced just prior to surgery, and the vagina is usually packed with gauze packing saturated with an antibiotic solution.

Operative Procedure.—A median suprapubic incision is made (Chapter 16). The urachus is clamped and cut. The bladder is freed and the scarred area that surrounds the fistulous tract is also freed. The peritoneal cavity is opened, the

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery and for vaginal hysterectomy.

Operative Procedure.—The major steps of the operation include the following: curettage of the uterus; dissection of the anterior vaginal wall and bladder; amputation of the cervix; opening of the vesicouterine peritoneal fold; and suturing the peritoneal flaps from the bladder to the posterior aspect of the uterus in such a manner that the uterus is mobilized under the bladder.

Operations for Stress Incontinence

Definition.—Through a vaginal or abdominal approach, repair of the fascial supports of the urethra, the bladder, and the bladder sphincter area.

Considerations.—Stress incontinence may occur due to exertion, such as arising from a sitting position, coughing, or lifting a heavy object. It results from relaxation or laceration of the fascial pelvic structures which normally hold the bladder and urethra in position.

Purpose.—To prevent involuntary urination.

Setup, Position, Skin Preparation, and Draping Procedure.—

1. *For vaginal operation,* as described for colpoperineoplasty, adding ribbon gut and a urethral sound.

2. *For vesicourethral suspension operation,* as described for cystectomy, including Foley catheter No. 16 F with a 5 or 30 ml. bag (Chapter 16). The patient is placed on the operating table in a slight Trendelenburg position.

Operative Procedures.—

For Vaginal Approach (Kelly and Kennedy Methods).—

1. A small Foley catheter is passed into the bladder. The posterior vaginal wall is retracted and an incision is made through the anterior vaginal wall down to the urethra and bladder.

2. The vaginal wall is dissected from the bladder and urethra; the neck of the bladder is sutured together with fine chromic gut, silk, or chromic ribbon gut. The wound is closed as described for vaginal repair.[4, 8, 21, 24, 26]

For Vesicourethral Suspension (Marshall-Marchetti-Krantz Method).—

1. Through a suprapubic abdominal incision the space of Retzius is entered and the bladder and urethra are freed from the surrounding structures.

2. Mattress chromic gut sutures No. 1 or 0 are inserted in the pubocervical fascia of the vaginal wall or either side of the urethra and bladder neck, and are then passed through the periosteum of the symphysis so as to support the urethra as close as possible to the symphysis pubis.

3. Additional sutures are introduced in the lower and lateral portions of the bladder wall and are attached to the posterior portion of the rectus muscles, thereby pulling the bladder anteriorly into the space of Retzius.

4. The wound is closed and drained with a Penrose tube.

Cervical Biopsy (Diagnostic Excision)

Definition.—Removal of a cervical tissue with a knife or forceps.

Purpose.—A cervical biopsy is done when suspected erosion or leukoplakia requires histologic examination.[10, 20, 24, 31]

Considerations.—Vesicovaginal interposition of the uterus may be performed in certain patients with specific situations. Because sterilization is unavoidable in this operation, it is seldom performed, and is not done on young women in whom fertility is to be preserved.[5, 25, 26]

Purpose.—To control urinary incontinence.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery and vaginal hysterectomy.

Operative Procedure.—The vaginal wall is incised and separated from the bladder. The supravaginal septum is divided and the vesicouterine plica exposed and divided. The uterine fundus is brought through the peritoneal opening into the vagina.

Bilateral salpingectomy is performed. The vesical margin of the vesicouterine fold is sutured to the posterior wall of the uterus. The uterus is positioned between the bladder and anterior vaginal wall.

Parametrial Fixation (Manchester Method)

Definition.—The Manchester operation and other modifications of the original Fothergill and Shaw operation in general include the following: amputation of the cervix, suturing of the cardinal ligaments and the anterior cervical stump, and repair of cystocele and rectocele (colpoperineorrhaphy).[4, 5, 20, 26]

Purpose.—To treat an incomplete prolapse of a healthy uterus.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery, including colporrhaphy and trachelorrhaphy setups.

Operative Procedure.—The major steps include the following:

1. Triangular denudation of the vaginal mucosa is done below the urethra downward, circumcising the cervix. The bladder is separated from the cervix.
2. The cervix is pulled upward, the sacrouterine ligaments and posterior portions of the parametria are exposed. The bladder is separated from the cervix and lower uterine segment. Sutures are inserted through the pubocervical tissue (bladder pillar). The bladder pillar is ligated and incised. Sutures are secured to the bladder pillars and to the uterine vascular bundles.
3. The cervix is amputated and trachelorrhaphy is performed. The opening in the pubocervical tissue and in the anterior vaginal mucosa is closed with interrupted sutures.

The Watkins Interposition Operation

Definition.—Through the vaginal outlet, repair of the anterior and vaginal walls, approximation of the vesicouterine, peritoneal folds, and peritoneal flaps from the bladder to the posterior aspects of the uterus

Considerations.—The Watkins interposition operation is generally performed in women past the menopause who are suffering from an incomplete prolapse of a normal healthy uterus or who have a prolapse of the uterus and a large cystocele.[5, 7, 20, 26]

Purpose.—To correct the cystocele and the position of the prolapsed uterus, which has fallen between the bladder and the anterior vaginal wall.

2. The outer portions of the cervix are grasped with a tenaculum, and the cervix is drawn toward the introitus; then the anterior speculum is removed.

3. The tip of the electrode is passed into the cervical canal and the diseased membrane removed.

4. The cervical canal is cleansed with an antiseptic solution.

5. If a wide conization is performed, the cervix may be sutured as described in Sturmdorf tracheloplasty.

Tracheloplasty (Sturmdorf Operation)

Definition.—Removal of torn surfaces of the anterior and posterior cervical lips and reconstruction of the cervical canal.

Purpose.—To treat deep lacerations of the cervix which is relatively free from infection, especially in women past the child-bearing age.

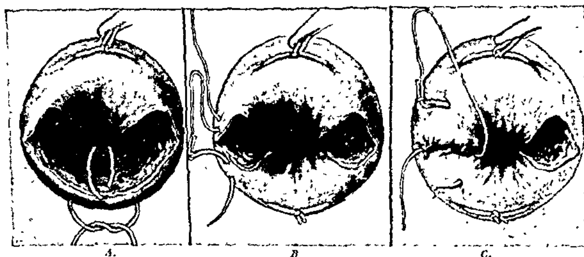


Fig 391.—*A*, The anterior flap has been drawn in, and the posterior main suture is in place ready to be tied *B*, Both main sutures tied The right lateral inverting suture is being started Notice that it is passed in a way to ensure inversion *of the margins*. *C*, The inverting portion of the right lateral suture is completed, and a deep bite is being taken to ensure hemostasis in this lateral area. (From Crossen, H. S, and Crossen, R. J.: Operative Gynecology, St Louis, The C V. Mosby Co)

Setup and Preliminary Preparation of the Patient.—As described for vaginal surgery. The setup includes a basic vaginal setup and the following:

- 1 Wylie uterine dilator (Fig. 364)
- 1 Goodell dilator (Fig. 364)
- 3 Hegar dilators, various sizes (Fig. 364)
- 3 Thomas curettes, dull, various sizes, if desired (Fig. 364)
- 2 Sims curettes, sharp, various sizes, *if desired*
- 1 Gelpi self-retaining retractor (Fig. 363)
- 1 Electrosurgical unit with cords and electrodes

Operative Procedure.—The steps, as shown *in Fig. 391, include* the following:

1. The labia is retracted, the cervix grasped with a tenaculum, and a circular incision made in the mucous membrane of the cervix external to the diseased portion.

2. The mucosa is dissected from the cervix near the level of the internal os so that a flap can be formed around the remaining cervix. The bleeding vessels are clamped and ligated.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for dilatation setup, adding the following: electrosurgical unit with cords, cutting and coagulation electrodes.

Operative Proceduce.—The labia, the posterior vaginal fornix, and the anterior vaginal wall are retarcted, using a speculum and a single or double tenaculum (Fig. 390) The lip of the cervix is grasped with a bullet forceps; a wedge-shaped piece of diseased and healthy tissue is excised with a scalpel or punch biopsy forceps (Fig. 390). An electrosurgical knife may be used. Excessive bleeding may be controlled by insertion of iodoform gauze packing into the vagina.

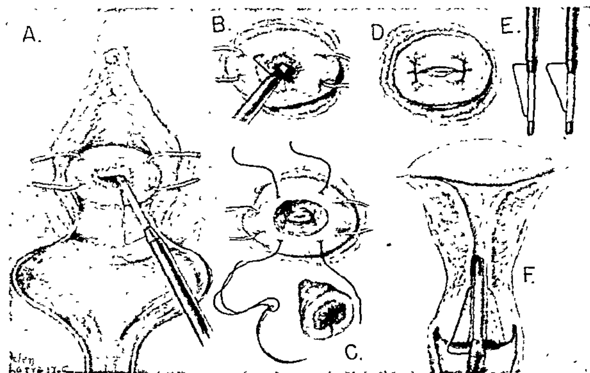


Fig 390—Cervical conization. *A*, Tenacula applied to cervix; electrode inserted *B*, Electrode inserted into internal os, being rotated. *C*, Cone of tissue removed In shallow conizations, operation stops here, otherwise suture as shown here and in *D*. *E*, Crossen electrodes. *F*, Section showing electrode in place and tissue to be removed (From Horsley, G W, and Bigger, I A Operative Surgery, St Louis, 1953, The C V Mosby Co)

Cervical Conization

Definition.—Removal of diseased cervical tissue with an active electrode inserted into the cervical canal and application of the cutting current of the high-frequency electric machine.

Purpose.—To treat strictures of the cervix and chronic cervicitis.[17, 21, 23, 24]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery. Set for dilatation of the cervix, adding electrosurgical unit with deconization and ball-type electrodes (Fig. 390). Safety measures against electric burns and explosion hazards must be carried out (Chapter 2).

Operative Procedure.—The major steps, as illustrated in Fig. 390, include the following:

1. The posterior vaginal wall is retracted by a speculum and the anterior vaginal wall by lateral retractors.

Steps	*Items*
2. The cervical canal is cleansed.	2. Plain gauze packing ½ inch wide and 5 inches long attached to Kocher forceps
3. The cervical canal is examined to determine direction and length of the uterine canal and to identify a stricture.	3. Sponges on holders, retractors, vulsellum and graduated uterine sound, Wylie or Goodell dilator, sterile lubricating jelly
4. The cervical os is dilated (Fig. 392).	4. Hank, Kelly, or Hegar dilators, then Goodell dilator, if necessary
5. The interior of the cervical canal and uterus is curetted, and a varying amount of tissue may be removed from the uterus; a specimen of tissue is obtained.	5. Sims uterine sharp curettes, specimen bottle containing normal saline solution; gauze pouch bag may be secured to speculum for obtaining specimen
6. For incomplete abortion the loose fetal membrane is grasped and removed. A drug may be injected into the cervix to stimulate contraction of uterine muscles.	6. Kelly placenta forceps, 2 ml. syringe and intramuscular needle, drug in ampule, steel file, sponges on holders
7. Blood clots are removed from the vaginal cavity, which may then be packed; the vulsellum forceps and retractors are removed, the vulva is cleansed, and perineal dressings are applied and held in place with a T-binder.	7. Sponges on holders, iodoform packing or plain gauze packing saturated with an antibiotic solution, perineal pad and binder, safety pin

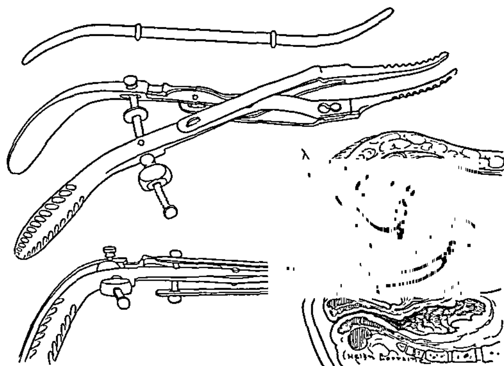


Fig 392 —Dilation of the cervix A Goodell dilator and one of a set of graduated dilators are illustrated. A weighted speculum is shown over the perineum and posterior vaginal wall. The anterior lip of the cervix has been grasped with a tenaculum and a Goodell dilator is inserted. (From Horsley, G. W, and Bigger, I. A: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co)

3. A portion of the cervix is removed in a cone-shaped manner by using a knife (Fig. 390).

4. The surface of the cervical cavity is covered with the circular flap of mucosa and secured by means of chromic gut Nos. 0 and 2-0 sutures swaged-on curved, trocar-point needles. The sutures are passed through the entire cervical wall down to the cervical mucosa. These sutures are tied to fix the cut edges of the mucous membrane to the severed edge of the cervical tissue, thereby completing reconstruction of the cervical canal (Fig. 391).

Amputation of the Cervix

Definition.—One of two types of amputation is done: a low cervical amputation, in which a part of the vaginal portion of the cervix is removed, or a high amputation, in which a part of the higher portion of the cervix is also removed.[5, 17, 20]

Purpose.—To remove the diseased portion of the cervix.[32]

Setup, Position, Skin Preparation, and Draping Procedure.—As for vaginal surgery. For a low amputation the setup for tracheloplasty operation is needed. For a high amputation a colphorrhaphy setup is used.

Operative Procedure for Low Cervical Amputation.—

1. The cervix is drawn downward and the cervical canal is dilated, using a blunt forceps.
2. The cervix is incised on both sides and tissue removed from each cervical lip. The wound is closed with chromic gut sutures.

Dilation of the Cervix and Curettage

Definition.—Introduction of instruments through the vagina and into the uterus, and, in some cases, removal of substances and blood.

Purposes.—To assist the surgeon in determining the cause of uterine bleeding or sterility and to obtain a specimen for pathologic examination; or to treat an acquired or congenital cervical stenosis; or to remove uterine polyps or retained products of conception following incomplete abortion; or to interrupt pregnancy as an emergency measure in certain cases.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery, including dilation and curettage setup as described previously in this chapter. A hysterectomy setup should be available for immediate use to control excessive bleeding in the peritoneal cavity.[10, 17, 20, 25]

Operative Procedure.—The steps (Fig. 392) and items (Figs. 363 and 364) include the following:

Steps	*Items*
1. The labia and posterior vaginal wall are retracted, the anterior lip of the cervix is grasped and exposed, and the anterior retractor inserted.	1. Auvard or Garrigue speculum, 2 Ferguson or Sims retractors, vulsellum forceps (single or double teeth), sponges on holders (Figs. 363, 366)

Operative Procedure.—

Steps	*Items*
1. The labia minora are sutured to the skin on each side.	1. Surgical gut chromic No. 2-0 or silk No. 3-0 and 3/8-circle cutting-edge needles, needle holder, tissue forceps
2. The skin overlying the Bartholin cyst or abscess is incised. The incision is carried down to the fascia; the vaginal mucosa is retracted.	2. Scalpel, tissue forceps, gauze sponges, retractors, Allis-Adair forceps, curved scissors
3. The cyst is removed or the abscess drained. The wound is loosely closed, drained, and dressed.	3. Sponges on holders, rubber tube, vaginal interrupted chromic gut No. 4-0 and Murphy needles, needle holders, tissue forceps, scissors, vaginal perineal pad binder

Vaginal Hysterectomy

Definition.—Through an incision made in the vaginal wall and the peritoneal cavity, the uterus is removed.

Considerations.—Vaginal hysterectomy is not done if a large uterine tumor is present or if the uterus is mobilized because of an inflammatory disease involving the adnexa.[4, 20, 30, 33]

Purpose.—To treat a complete prolapse of a healthy uterus in selected patients or an incomplete prolapse of a diseased uterus.[30, 33]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery. A colporrhaphy setup and the following items.

6 Heaney hysterectomy forceps, 7¼ inches (Fig. 366)
4 Phaneuf forceps, curved, 7¼ inches
2 Kelly tissue forceps, 7¼ inches
4 Pean forceps, curved, 7¼ inches
1 Asepto syringe, 2 ounces
1 Mayo-Hegar needle holder, 8 inches
1 Foley catheter No. 14 or 16 F with 5 ml. bag

Operative Procedure (Ligature Method).—The steps, as illustrated in Figs. 393 to 399, include the following:

Steps	*Items*
1. Dilation and curettage may be performed (Fig 392).	1. As described previously for dilation and curretage.
2. The cervix is drawn downward. The incision is started below the meatus, progressing around the cervix; then the anterior vaginal wall is opened and partly dissected.	2. Tenaculum or vulsellum forceps, *scalpel*, Ochsner forceps, tissue forceps with teeth, lateral retractors, gauze sponges, curved scissors, Pean and Crile hemostats, ligatures—chromic gut No. 3-0

Colpotomy

Definition.—

Anterior Colpotomy.—Through the vaginal outlet, an opening is made in the vesicouterine pouch as a preliminary part of extensive vaginal operation which requires exposure of the uterus.

Posterior Colpotomy.—Through the vaginal outlet, the peritoneal cul-de-sac is opened, and pus and blood are removed.

Purpose.—For diagnostic purposes in determining retrouterine hematocele or a cul-de-sac abscess.

Considerations.—If old blood is obtained on aspiration of the cul-de-sac, the abdominal peritoneal cavity may be opened abdominally and explored. The presence of old blood is an indication of extrauterine pregnancy. If pus is not aspirated, the colpotomy is not performed.

Setup, Position, Skin Preparation, Draping Procedure.—As described for vaginal surgery, adding the following:

2 Rubber drainage tubes, ½ inch in diameter, 10 inches long (Fig. 365)
Gauze packing 1 inch wide
2 Aspirating needles, gauge 12 or 14, 3½ inches
2 Syringes, each 20 ml.
Celiotomy setup (Chapter 11)

Operative Procedure.—

1. The labia are retracted, and the posterior lip of the cervix is grasped with a vulsellum.
2. A long aspirating needle attached to a syringe is inserted into the pelvic abscess.
3. A transverse incision is made through the posterior vaginal wall, near the cervix, and continued to the peritoneum. The incision is carried through the posterior vaginal fornix into the abscess cavity. Long, blunt-pointed, curved scissors are used
4. The cavity is drained with a soft rubber tube. The lateral angles of the wound are closed until sutures and dressings are applied to the wound surface.

Excision of Bartholin Gland Cyst

Definition.—Through the vaginal outlet, the cyst is removed or incised and the gland drained.

Purpose.—To treat an infected cyst in the Bartholin gland.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery, omitting vulsellum forceps but adding the following items:

2 20 ml. syringes
2 Culture tubes
2 Smear slides
1 Soft rubber drain or catheter

Operative Procedure.—

Steps	*Items*
1. The labia minora are sutured to the skin on each side.	1. Surgical gut chromic No. 2-0 or silk No. 3-0 and 3/8-circle cutting-edge needles, needle holder, tissue forceps
2. The skin overlying the Bartholin cyst or abscess is incised. The incision is carried down to the fascia; the vaginal mucosa is retracted.	2. Scalpel, tissue forceps, gauze sponges, retractors, Allis-Adair forceps, curved scissors
3. The cyst is removed or the abscess drained. The wound is loosely closed, drained, and dressed.	3. Sponges on holders, rubber tube, vaginal interrupted chromic gut No. 4-0 and Murphy needles, needle holders, tissue forceps, scissors, vaginal perineal pad binder

Vaginal Hysterectomy

Definition.—Through an incision made in the vaginal wall and the peritoneal cavity, the uterus is removed.

Considerations.—Vaginal hysterectomy is not done if a large uterine tumor is present or if the uterus is mobilized because of an inflammatory disease involving the adnexa.[4, 20, 30, 33]

Purpose.—To treat a complete prolapse of a healthy uterus in selected patients or an incomplete prolapse of a diseased uterus.[30, 33]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery. A colporrhaphy setup and the following items

6 Heaney hysterectomy forceps, 7¼ inches (Fig. 366)
4 Phaneuf forceps, curved, 7¼ inches
2 Kelly tissue forceps, 7¼ inches
4 Pean forceps, curved, 7¼ inches
1 Asepto syringe, 2 ounces
1 Mayo-Hegar needle holder, 8 inches
1 Foley catheter No. 14 or 16 F with 5 ml. bag

Operative Procedure (Ligature Method).—The steps, as illustrated in Figs. 393 to 399, include the following:

Steps	*Items*
1. Dilation and curettage may be performed (Fig. 392).	1. As described previously for dilation and curretage.
2. The cervix is drawn downward. The incision is started below the meatus, progressing around the cervix; then the anterior vaginal wall is opened and partly dissected.	2. Tenaculum or vulsellum forceps, scalpel, Ochsner forceps, tissue forceps with teeth, lateral retractors, gauze sponges, curved scissors, Pean and Crile hemostats, ligatures—chromic gut No. 3-0

Steps	*Items*
3. The bladder is dissected free from the anterior surface of the cervix, then retracted anteriorly (Fig. 393).	3. Tissue forceps, Allis-Adair forceps, Pean forceps, bladder retractor, chromic gut No. 0 or 2-0, scissors, 2 Ferguson or Deaver retractors
4. The vesicouterine fold of peritoneum is incised. The incision around the cervix is completed. The cardinal uterosacral ligaments and uterine vessels are ligated and divided on both sides (Figs. 394 to 396).	4. Tissue forceps, knife, curved scissors, Allis forceps, Pean forceps, Ochsner, Heaney, or Phaneuf clamps; chromic gut No. 0 or 2-0 and ½-circle Mayo or swaged-on needles, needle holders
5. The uterine peritoneum is incised, the adnexa are identified, and the uterus is delivered. The uterus and the adnexa are removed, if necessary (Fig. 397).	5. Tissue forceps, scalpel, curved scissors, Allis-Judd or Allis-Adair forceps, Pean forceps, vulsellum forceps, self-retaining vaginal retractor or lateral retractors, chromic gut No. 0 and 2-0, laparotomy pads, Heaney forceps, scissors
6. The uterovesical peritoneal flap is sutured to the severed ends of the round ligaments; the round ligaments are fixed to the pubic arch on either side of the urethra (Fig. 398).	6. Interrupted chromic gut No. 2-0 and Mayo needle No. 4, needle holders, sponges on holders
7. The uterosacral ligaments are approximated to the base of the broad ligaments which are held with "guy" sutures.	7. Chromic gut No. 1 or 2-0, swaged-on or threaded needle ½-circle trocar-point, needle holders, Pean forceps
8. Beginning above, the cut edges of the broad ligaments are sutured together. The cervical portion of the broad ligament or cardinal ligament is then sutured to the vaginal apex to provide support to the vaginal wall (Fig. 398).	8. Continuous chromic gut No. 2-0, or 3-0, suture needles on ½-circle Mayo needles Nos. 3 or 4 trocar-point, long needle holders, Kelly or Russian tissue forceps, Mayo-Pean hemostats, Ochsner forceps, interrupted chromic gut sutures, free ends of "guy" sutures threaded to Mayo needles, needle holder, sponges on holders, scissors
9. The mucous membrane is closed; the posterior vaginal wall is repaired (Fig. 399).	9 Interrupted chromic gut or silk No 2-0 or 3-0, ½-circle swaged-on intestinal needles, tissue forceps, Crile hemostats and needle holders; instruments and sutures as described for colporrhaphy

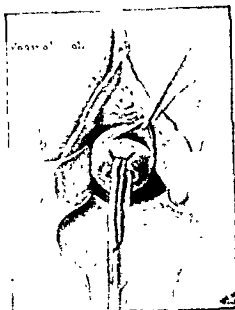


Fig 393.

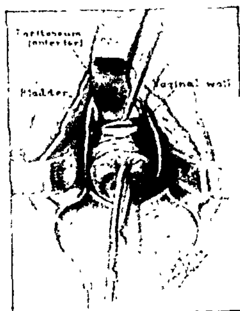


Fig. 394.

[illegible] method. The incision of the vaginal wall around [illegible] elevated. (From Counseller, V. S., in Lowrie: [illegible] 1955, Charles C Thomas, Publisher.)

Fig. 394.—Vaginal hysterectomy by ligature method—cont'd. Deaver retractor on each side; one Deaver retractor under the bladder. Peritoneum opened. (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.)

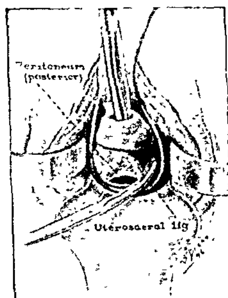


Fig 395

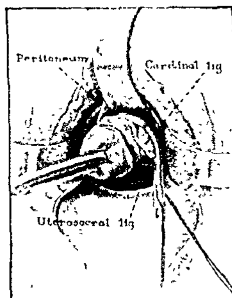


Fig. 396.

Fig. 395.—Vaginal hysterectomy by ligature method—cont'd. Posterior cul-de-sac opened. Heaney clamp applied to left uterosacral ligament. (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.)

Fig. 396.—Vaginal hysterectomy by ligature method—cont'd. Left uterosacral ligament cut and tied. Clamp applied to the left cardinal ligament. (From Counseller, V. S., in Lowrie: Gynecology. Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.)

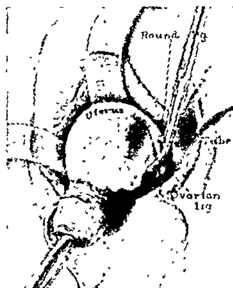


Fig 397.—Vaginal hysterectomy by ligature method—cont'd. Clamp applied to the ovarian ligament, round ligament, and fallopian tube. (From Counseller, V. S., in Lowrie. Gynecology Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher.)

Fig 398—Vaginal hysterectomy by ligature method—cont'd Reconstruction of the vaginal vault *a*, Uterosacral ligament, broad ligament, and round ligament are shown in their respective normal position *b*, Peritoneum is being closed and the cardinal, broad ligament, and uterosacral ligaments are being reattached to the angle of the vagina They are being pulled laterally. *c*, The left uterosacral and broad ligaments are being anchored to the left angle of the vagina and the pubocervical fascia and rectovaginal fascia are being closed together with the closure of the vaginal vault (From Counseller, V S, in Lowrie. Gynecology. Surgical Techniques, Springfield, Ill, 1955, Charles C Thomas, Publisher)

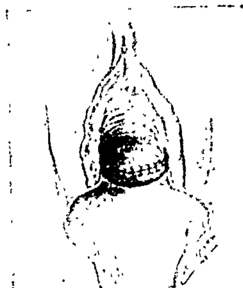


Fig. 399.—Vaginal hysterectomy by ligature method—cont'd. Complete closure of the vaginal vault. Repair of the pelvic floor (cystocele and rectocele), which is often necessary, is done according to the technique detailed for vaginal repair. (From Counseller, V. S., in Lowrie: Gynecology, Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher)

Irradiation Therapy

Definition.—Application and implantation of radium or radon into the vagina and the uterine cavity in the presence of a suspected or cancerous lesion.[7, 11, 29, 32]

Considerations.—Before a plan of radium therapy is decided upon, the suspected cancer lesion is classified according to the physical findings at the time of the vaginal and rectal examinations. The diagnosis is confirmed by the report of a cytologic (Papanicolaou) biopsy and by histologic examinations.[5, 11, 19, 22, 32]

Purpose.—To destroy and prevent the spread of a suspected nonmalignant lesion or a cancerous lesion which involves the cervix or the uterine cavity, or to treat selected patients with menopausal uterine bleeding or uterine tumor, or as a palliative measure in controlling carcinoma of the ovary. Intrauterine application of radium aims to treat carcinoma in the pelvic lymph glands and cervix, either alone or in combination with an operation.[8]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for vaginal surgery. The basic vaginal setup and the following:

1 Mayo scissors, heavy
3 Forceps for handling and applying radium to cervix or uterine cavity

For insertion of *radium needles,* add the following:

Silver wire suture
Plastic tissue forceps, 3 inches
Hemostatic forceps, 8 inches
Heavy scissors

For insertion of *tubes and capsules* (intrauterine application), add the following:

Brass screen storage container
Rubber tubing as screen
Chromic gut or silk No. 0 or 1 to secure tubes in place
Stilette for threading tubes
Scissors
Needles and needle holder

For insertion of *colpstat* (cervical application), add the following:

Vaginal packing
Tubes or capsules

For insertion of *radon seeds* add the following:

Applicators
Petrolatum
Plastic forceps
Container for storage of seeds

Also

Antibiotic mixture
Foley catheter No. 14 or 16 F with 5 ml. bag
Vaginal packing
Gloves and forceps for handling radium

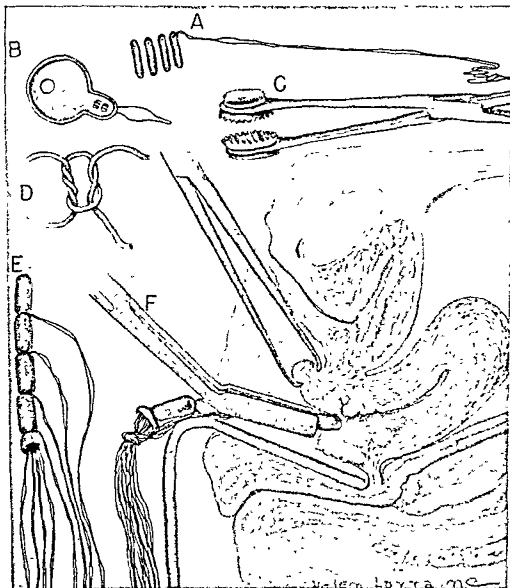


Fig. 400—Intrauterine radium. *A*, Platinum capsules of radium. *B*, Needle threader. *C*, Rubber-shod clamp for handling radium. *E*, Rubber capsule in which the threaded radium units are in tandem. Thread, using knot *D*, is tied between units to prevent overlapping. *F*, Instrument for inserting tandem. (From Horsley, G W, and Bigger, I A.: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co)

The operators and assistants must carry out specific safety measures to protect themselves and the patient from overexposure of radium which may produce serious reactions and burns. Carelessness in handling radium may result in degenerative blood changes and development of skin carcinoma. Lost radium becomes a serious hazard to persons who may come in contact with it (Chapter 4.)

Operative Procedure.—The radium is prepared and applied to the cervix or the uterine cavity (Fig. 400). A Foley catheter is inserted into the bladder Fig. 401).

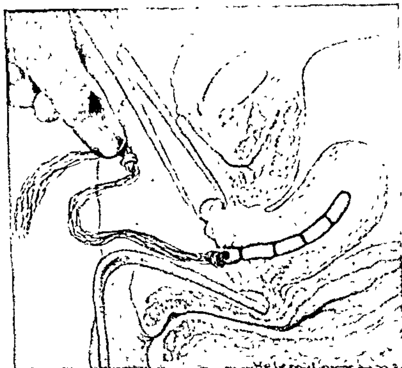


Fig. 401.—Intrauterine radium. The tandem has been inserted into the uterus. All threads are left long and are brought out and fastened to the thigh with adhesive tape. (From Horsley, G W. and Bigger, I. A.: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co)

Abdominal Hysterectomy (Total)

Definition.—Through an abdominal incision, the peritoneal cavity is opened and the entire uterus with or without adnexa is removed.

The term abdominal hysterectomy may refer to a total removal of the uterus, known as panhysterectomy, or to a subtotal hysterectomy.

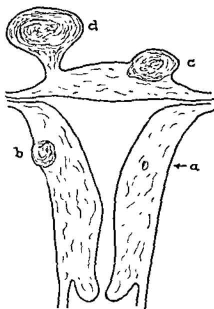
Considerations.—The operation to be performed will depend upon the type and location of the tumor, its histologic grade, and the age of the patient. Subtotal hysterectomy may be done in the presence of multiple myomas.[10, 20] Total hysterectomy is generally done on patients with retrocervical endometriosis or with carcinoma of an ovary.[27, 34]

Purposes.—To treat a cancer of the cervix and uterus; to treat uncontrollable bleeding from peritoneal adhesions; to relieve clinical symptoms such as hemorrhage, necrosis, and septic degeneration due to the presence of myomas.[8, 27, 32]

Setup, Position, Skin Preparation, and Draping Procedure.—Vaginal skin preparation setup, and celiotomy setup for abdominal gynecologic operations, adding the following:

6 Heaney forceps — 4 Phaneuf forceps

The patient is placed on the operating table in a Trendelenburg position as described previously in this chapter. Routine skin preparation is done (Chapter 3), and the patient is draped with towels and a fenestrated sheet, as described and illustrated in Chapter 4.



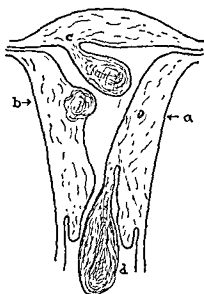


Fig 402 *Fig 403*

Fig 402 —Various types of myomas *a*, Ordinary intramural myoma; *b* and *c*, subperitoneal myomas, *d*, pediculated subserous myoma (From Crossen, H S, and Crossen, R. J: Synopsis of Gynecology, St Louis, The C V Mosby Co)

Fig 403 —Myomas tending to expand toward the uterine cavity *a*, Ordinary intramural myoma, *b*, submucous myoma, *c*, pediculated submucous myoma, *d*, pediculated submucous myoma forced through the cervical os by uterine contractions (From Crossen, H. S, and Crossen, R J Synopsis of Gynecology, St. Louis, The C V Mosby Co)

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. The skin is incised from below the umbilicus to the suprapubic fold; the fat and superficial fascia are incised (Chapter 11). The bleeding vessels are clamped and ligated Skin towels are applied to the wound edges	1 Scalpel, sponges, Crile hemostats, Allis forceps, 2 Roux or Parker retractors, ligatures of plain or chromic surgical gut No. 2-0 or 3-0, scissors, 2 skin towels, towel forceps, 2 Pean hemostats, 2 surgical towels
2. The skin and subcutaneous fat are retracted, then the anterior rectus fascia is incised and retracted.	2 2 Roux or Parker retractors, scalpel, gauze sponges, 2 Richardson retractors

Steps	*Items*
3. The posterior rectus sheath is separated and retracted; the transversalis fascia and peritoneal fat are opened; and the peritoneal sac is opened and retracted. The abdominal cavity is explored.	3. Sponges on holders, 2 tissue forceps, scalpel, Crile hemostats, curved scissors, suction set, laparotomy pads, deep abdominal retractors, suture ligatures
4. The uterus and adnexa are examined; the fundus of the uterus is grasped and delivered into the wound. The pelvic cavity is lined with moist pads and a piece of rubber dam.	4. Self-retaining abdominal retractor, deep Richardson, Deaver, or Ferguson retractor, large laparotomy pads, large piece of rubber dam, vulsellum and tenaculum forceps, long tissue forceps with teeth
5. The uterus is retracted; the round ligaments and their accompanying arteries are clamped and ligated, leaving ligatures long. Suture ends are cut between the clamps and the ligature (Fig. 404).	5. Heaney forceps, long curved Pean forceps, Ochsner artery forceps if desired, long tissue forceps, moist gauze sponges on holders, chromic gut No. 0 and Mayo needles No. 3 with taper-point, Crile hemostats, curved scissors
6. The portion of the peritoneum that involves the dome of the bladder is divided and displaced from the anterior wall of the uterus.	6. Judd-Allis or Allis-Adair forceps, long tissue forceps with teeth, long curved scissors, sponges on holders, moist pads
7 The cervicovesical ligament from the uterine wall is cut, and the uterine vessels are exposed by separating the avascular portion of the broad ligaments; then they are doubly clamped and ligated (Fig. 404).	7. Pean hemostats, scissors with curved blades, Carmalt, Pean, or Ochsner hemostatic clamps, Phaneuf forceps, chromic gut No. 1 or 0, long curved or straight scissors or scalpel with long handle
8 The uterus is drawn upward, the paracervical tissue is dissected free by blunt and sharp dissection. Bleeding vessels are clamped and ligated. In the anterior midline the cervix is dissected away from the base of the bladder and the uterus, until the anterior reflection of the vaginal mucous membrane is reached.	8 Vulsellum forceps, Deaver retractor, 2 long tissue forceps with teeth, long curved dissecting scissors, 2 laparotomy pads with rings attached, Mayo-Pean, Ochsner, and/or Phaneuf hemostatic forceps, chromic gut Nos 0 and 2-0, suture scissors, sponges on holders.
9 The vagina is opened and the edges are grasped; the cervix is dissected free and, in so doing, the bladder, ureters, and rectum are protected The uterus is removed.	9. Scalpel, long Allis-Adair forceps, Mayo-Pean, Heaney, or Ochsner hemostats, scissors, sponges on holders, vulsellum, moist laparotomy pads, specimen basin, suture ligatures

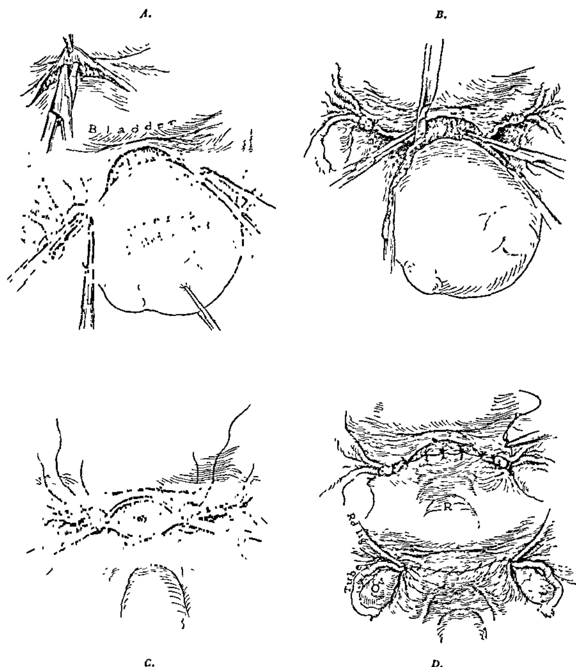


Fig 401.—Abdominal hysterectomy (Curtis) *A*, Prevesical peritoneum incised and dissected. Double clamping of tubes and round ligaments *B*, Broad ligaments ligated by figure-of-eight stitch Uterine arteries clamped, including bite into cervix. *C*, Uterine arteries ligated with chromic gut sutures No 1 or 0, including portion of cervical stump. Amputation conical incision *D*, Incision margins approximated with interrupted sutures Peritonealization of entire area completed. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N J)

Steps	*Items*
10. A drain or a strip of medicated gauze packing may be inserted into the vagina and the vagina closed.	10. Piece of soft rubber tubing, narrow diameter and 10 inches long, 1-inch gauze packing saturated with antiseptic solution, long tissue forceps without teeth
11. The divided ends of the round ligaments are peritonealized. The pelvic cavity is cleansed, retractors and laparotomy pads are removed, and the bowel and omentum are replaced in normal position (Fig. 401).	11. Continuous suture chromic gut No. 3-0, needle holder, tissue forceps with teeth, sponges on holders, Pean hemostats
12. The recti muscles are retracted and the peritoneum is grasped and approximated; the recti muscles are approximated and the edges of the anterior recti fascia are approximated (Chapter 11).	12. Moist laparotomy pads, 2 Richardson retractors, sponges on holders, ribbon retractor, Mayo-Pean hemostats, chromic gut No. 2-0, swaged-on ½-circle taper-point needles, 2 needle holders, scissors; pad count verified; fresh towels applied to wound edges; interrupted chromic gut No. 0 or 2-0
13. The subcutaneous tissue and superficial fascia are closed; the skin is closed with interrupted sutures, and dressings are applied to the wound and secured with adhesive tape or other suitable material.	13. 2 Roux or Parker retractors, chromic gut No. 3-0 swaged-on ½-circle Mayo or Murphy needles, tissue forceps with teeth, sponges on holders; silk No. 4-0 or nylon No. 5-0, Keith needles or skin clips and holders for skin closure, gauze dressings

Supracervical Hysterectomy

Definition.—Through an abdominal incision, the peritoneal cavity is opened, the uterus is transected halfway across the isthmus of the cervix, and the upper portion of the uterus removed. The cervical stump is closed and the round ligaments sutured to it. The wound is closed.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for total hysterectomy.

Operative Procedure.—The steps and items used are similar to those described for total hysterectomy. Chromic gut sutures No. 0 or 2-0 are used to close the cervical stump. The wound is closed in layers as described for total hysterectomy and for celiotomy (Chapter 11).

Hysterectomy, Bilateral Salpingo-oophorectomy, and Iliac Lymphadenectomy (Wertheim Operation)

Definition.—Through a long left paramedian incision (Chapter 11), which extends from the crest of the superior ramus of the pubis to the umbilicus, the

following organs are removed: uterus, tubes, parametria, uterosacral ligaments, upper half of the vagina, and the iliac and obdurator nodes on both sides.

Purpose.—To treat some patients with carcinoma of the cervix, usually grade I, or in cases when surgery is the only suitable method to treat the cancerous lesion.[8, 11, 32]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for abdominal hysterectomy, adding the following:

2 Deaver retractors, $1\frac{1}{2}$ inches wide, $12\frac{5}{8}$ inches long
4 Pean forceps, curved jaw, 8 inches
4 Heaney or Phaneuf forceps, curved jaw, $7\frac{1}{2}$ inches
1 Masson needle holder, $10\frac{1}{2}$ inches
1 Mayo-Harrington or Nelson scissors, 11 inches
1 Ureteral grasping forceps
1 Cushing vein hook, $7\frac{3}{4}$ inches
1 Kelly tissue forceps, 9 inches
Cameron light or lighted retractor, cord attachment and rheostat
4 Wertheim right-angled clamps
2 Mayo (portable) draped stands for instruments

Operative Procedure.—The major steps and items include the following:

1. The abdomen is opened, moist gauze pads and a self-retaining retractor with blades are placed in the wound, and the peritoneal cavity is explored.

2. In some cases the dissection is started on the right side. Ochsner or Heaney forceps are placed on the broad ligament, and the uterus is retracted with a vulsellum forceps and retractor. The right infundibulopelvic ligament and the ovarian vessels are clamped, cut, and ligated. The ureter is preserved. The uterine vessels lying along the anterior aspects of the ureter, the cardinal ligament, and the fascial layer which separates the ureter from the cervix are dissected free.

3. The peritoneal and the vesicouterine folds are incised so that the bladder can be dissected away from the cervix.

4 The uterus is retracted toward the left side and dissection is carried out on the right side.

5. The posterior parietal peritoneum is incised; the rectum is separated from the vagina, then the uterosacral ligaments are cut and ligated.

6 Hemostats are placed across the vagina which is still attached to the freed uterus, the vagina is transected distal to the hemostats The specimen is removed and the vaginal stump closed as described for total hysterectomy.

7 A bilateral iliac lymphadenectomy (Taussig procedure) is carried out. The major steps include removal of the pelvic lymph nodes and associated tissues that lie along the common iliac artery, the external iliac artery, and the hypogastric artery, as well as tissues near its branches. The lymph nodes are removed from the corresponding veins, the obturator nerve, the obliterated hypogastric artery, and the ureters[26]

8 The wound is closed as described for total hysterectomy.

Myomectomy

Definition.—Through an abdominal incision, the myomas (benign tumors) are removed from the uterus.

Considerations.—The most common tumors of the uterus are composed of unstriped muscle and fibrous connective tissue. There are various types of uterine myomas as shown in Fig. 402. These tumors generally are classified in relation to their anatomic location (Fig. 403). Surgical treatment generally is the treatment of choice for young women and irradiation therapy for women over 40 years of age.[10, 12, 29, 34]

Purposes.—To relieve pelvic discomfort, especially at the time of menstruation, to control abnormal bleeding, and prevent expansion of the lesion which may interfere with the process of childbearing.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for abdominal hysterectomy. Because of the difficulty associated with removal of some tumors, a hysterectomy setup is prepared. The special instruments required for myomectomy include the following:

- 1 Doyen tumor screw
- 1 Kelly or Mayo tenaculum hook
- 1 Skene uterine tenaculum forceps
- 1 Collins uterine elevating forceps (Fig. 365)
- 1 Bonney forceps, optional
- 1 Syringe, 2 ml.
- 1 Intramuscular needle
- 1 Ampule of surgical pituitary extract or similar drug
- 1 Vaginal setup, optional
- 1 Vaginal preparation setup

Operative Procedure.—The major steps include the following:

Steps	*Items*
1. The patient generally is placed on the operating table in a lithotomy position. The vagina is cleansed and the bladder emptied. Following, the patient is placed on the operating table in a Trendelenburg position and prepared for the abdominal operation as described for hysterectomy.	1. Lithotomy position (Fig. 367), lithotomy draping procedure (Fig. 368), [illegible] 369), [illegible] drapi[illegible] and 4)
2. Through a midline or Pfannenstiel abdominal incision (Chapter 11), the uterus is exposed.	2. As described for celiotomy (Chapter 11) and hysterectomy
3. The uterus is mobilized and the uterine wall incised to expose the tumor. The tumor is grasped and dissected free. All bleeding vessels are clamped and ligated	3. Retractors, laparotomy pads, tenaculum hook, vulsellum forceps, scalpel, scissors, forceps, tumor screw and elevating forceps, injection of drug into the uterine wall, sponges on holders
4 The cavity left by the tumor is closed by approximation of the uterine wall.	4. Interrupted chromic gut sutures No 2-0 swaged-on Mayo needle with trocar-point, needle holders. tissue forceps, scissors
5 The wound is closed in layers and dressings are applied.	5. As described for celiotomy (Chapter 11)

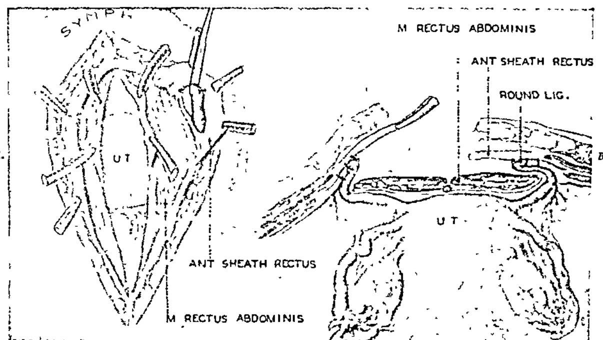


Fig 405—*A*, Gilliam suspension operation (modified). The loop of round ligament which is spread out and fastened with interrupted sutures of silk to the undersurface of the anterior rectus sheath. The traction suture will be withdrawn. *B*, A horizontal section, showing the operation completed except for the closure of the anterior rectus sheath, subcutaneous fascia, and skin. Note that there is no passage lateral to the displaced round ligaments. (From Horsley, G. W., and Bigger, I A: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co.)



Fig 406—Baldy-Webster operation for retroflexion of the uterus (Courtesy Rubin, I. C., and Novak, J.: Integrated Gynecology, vol III, copyright, 1956, Blakiston Division, McGraw-Hill Book Co., Inc.)

Suspension of the Uterus (Abdominal Hysteropexy)

Definition of Operations.—Through an abdominal incision one of several operations is selected. They include the following: (1) the Gilliam suspension operation and its modifications, in which a loop of the round ligaments is drawn through an opening made on each side in the recti muscles and the loop sutured to the anterior recti sheaths (Fig. 405); (2) the Baldy-Webster or Coffey operation, in which the round ligaments are brought through openings made in the folds of the broad ligaments at a point beneath the ovarian ligaments (Fig. 406); (3) the Olshausen operation, which is similar to the Gilliam method (a loop of the round ligaments at a point near their uterine attachment is inserted through the anterior abdominal wall and is brought back into the peritoneal cavity, and the round ligaments are anchored to the anterior peritoneum); (4) the Alexander-Adams operation, in which the round ligament on each side is drawn through the inguinal canal, the ligament shortened by either partial resection or overlapping of the loop, holding it in place with sutures.[19, 24, 26]

Purpose.—Hysteropexy is done to treat retroflexion or other malpositions of the uterus in women with severe pelvic discomfort which has not been relieved by manual replacement of the uterus or by insertion of a properly fitted pessary.

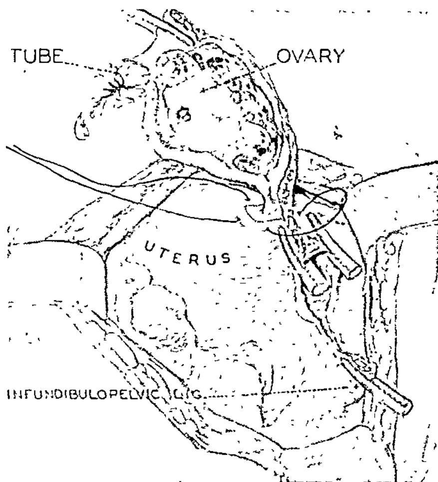
Setup, Position, Skin Preparation, and Draping Procedure.—To prepare the vagina, a vaginal preparation set and items for lithotomy position are needed. Equipment includes a hysterectomy setup, omitting Heaney, Phaneuf, and vulsellum forceps, but including 2 Barrett suspension forceps. Following vaginal preparation, the patient is placed in a Trendelenburg position (Chapter 4) and prepared as described for abdominal hysterectomy.

Operative Procedure (Simpson Modification of Gilliam Hysteropexy).—The steps (Fig. 405) include the following:

Steps	*Items*
1. The abdomen is opened, the pelvic cavity explored, and the uterus exposed.	1. As described for opening a celiotomy (Chapter 11) and for abdominal hysterectomy
2. Transfixion sutures are introduced beneath the round ligaments or these ligaments are held in suspension.	2. Chromic gut or silk No. 2-0 or 3-0, Murphy needle, needle holder, tissue forceps, or Allis-Adair forceps, laparotomy pads
3. On each side a forceps is introduced into the fibers of the rectus muscle and brought out to the internal inguinal ring. The end of the clamp is then inserted into the folds of the broad ligament and through the anterior fold at a point near the transfixion sutures; the ends of the sutures are grasped and brought beneath the anterior sheath of the rectus muscle and anchored.	3. Long curved forceps, scalpel, scissors, sponges on holders, tissue forceps without teeth, Crile hemostats; ends of free sutures threaded on needle, needle holder; anatomic structure of abdominal wall described and illustrated in Chapter 11
4. The wound is closed in layers and dressings are applied.	4. As described for celiotomy (Chapter 11)



Fig 407.—Conservative surgery of ovary and tube Excision of damaged portion of tube, showing how the end of the stump is split and sewed open Excision of cyst from ovary with preservation of the unaffected portion of the organ. Lesions are shown on the right side and conditions after excision on the left side of drawing (From Crossen, H S, and Crossen, R. J: Operative Gynecology, St. Louis, 1918, The C. V Mosby Co)



[illegible] 'opelvic ligament containing the ovarian [illegible] identified and protected The broad liga- [illegible] placed inferior to the adnexa. A suture [illegible] al attachment A wedge of cornu is excised when the tube, ovary, and cornical wedge are removed. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, St Louis, 1953, The C V Mosby Co)

Salpingo-oophorectomy

Definition.—Through a low abdominal incision, the ovary and tube are removed. When the ovary is removed, the operation is called an oophorectomy; when the fallopian tube is removed, the operation is known as a salpingectomy.

Considerations.—The choice of operation depends upon the patient's symptoms, findings on physical examination, and direct examination of the adnexa during exploration. If the ovarian tumor is recognized as benign, only the visibly diseased portions of the adnexa are removed. In the presence of dermoid, follicle, and corpus luteum cysts, the cyst is usually enucleated and most of the ovarian parenchyma is preserved.[5, 20, 21] In tubal pregnancy the pregnant tube is removed and, in some cases, the ovary also.

Purpose.—Salpingo-oophorectomy is done to remove ovarian and tubal tumors, to treat ectopic pregnancy, tuberculosis of the adnexa, endometriosis of the ovaries (chocolate cysts), or a chronic inflammatory condition with frequent severe attacks of pain.

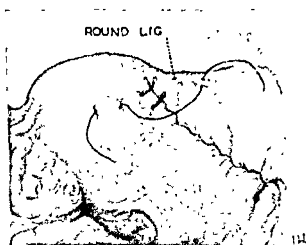


Fig. 409—Salpingo-oophorectomy. The uterine suture has been tied and ovarian vessels have been ligated; reperitonealization has been completed. The round ligament with adjacent portions of the broad ligament is sutured to the fundus to cover the uterine wound to decrease the risk of adhesions and to bring the uterus forward for better support. (From Horsley, G. W., and Bigger, I. A.: Operative Surgery, St. Louis, 1953, The C. V. Mosby Co.)

Setup and Preliminary Preparation of the Patient.—As described for abdominal hysterectomy, omitting Heaney and Phaneuf forceps, and heavy vulsellum forceps.

Operative Procedure.—The steps, as shown in Figs. 407 to 409, and the items include the following:

Steps	*Items*
1. Through a midline, paramedian, or Pfannenstiel incision (Chapter 11), the peritoneal cavity is opened and the uterus, ovaries, and tubes are examined.	1. As described for celiotomy (Chapter 11) and for abdominal hysterectomy

Steps	*Items*
2. The infundibulopelvic ligament is tied, clamped, and divided.	2. Chromic gut No. 0 or 2-0 on Mayo needle, needle holder, tissue forceps, Crile or Mayo-Pean hemostats, scissors, laparotomy pads
3. The mesosalpinx is tied or clamped, and divided with the suspensory ligament of the ovary.	3. Chromic gut No. 2-0, Mayo-Pean hemostats, scissors, suction set, laparotomy pad
4. The cornual attachment of the tube is excised. Bleeding vessels are clamped and ligated.	4. Scalpel, Mayo-Pean hemostats, curved scissors, chromic gut No. 2-0 or 3-0
5. Edges of the broad ligament are peritonealized from the uterine horn to the infundibulopelvic ligament.	5. Continuous suture chromic gut No. 2-0 or 3-0 swaged-on or Murphy needle, needle holder, tissue forceps, scissors
6 The wound is closed in layers and dressings are applied.	6. As described for closure of a celiotomy (Chapter 11)

Salpingostomy

Definition.—Through an abdominal incision, the peritoneal cavity is explored and the tube exposed and repaired.

Considerations.—The Sovak and Rubin operations appear to be the most successful.

Purpose.—To open the occluded tube in order to relieve sterility.[26]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for basic gynecologic abdominal surgery, adding the following: chromic gut No. 4-0 or 5-0 swaged-on intestinal needles, cannula-Bonney clamps, Sovak reamer, fine-caliber polyethylene tubing, plastic tissue forceps and scissors (Fig. 365). The patient is placed on the operating table in a slight Trendelenburg position and prepared as described for abdominal hysterectomy.

Operative Procedure.—

Rubin Method and Modifications.—

1. Through an abdominal incision, the tube is exposed; the blunt opening of the closed fimbriated end of the tube is opened with a fine forceps.

2 A cuff is made and the mucosa sutured to the seromuscular coat with fine chromic gut sutures.

3. In some cases the tubal lining is turned back and the everted mucosa is sutured to the serosa. The tip of the occluded tube is excised.

Sovak Method and Modifications—

1. Through an abdominal incision, the tube is exposed and divided.

2. A Bonney clamp is placed near the amputated end of the tube. A circular cut is made below the clamp and through the tubal wall down to the mucosa. The tubal end is grasped with fine forceps and pulled back as the Bonney clamp is pushed forward.

3. The reflected tube is sutured in place with fine sutures, and the adnexa are sutured to the parietal peritoneum.

4. In cases where the interstitial portion of the tube is obstructed, it is dissected from the uterus. A tunnel is made in the uterine wall and the tube pulled into the uterus through the reamed-out canal.

5. The wound is closed in layers and dressings are applied as described for closure of celiotomy.

Note: In some cases fine-caliber polyethylene tubes are passed from the ends of the tubes down into the uterine cavity and left in place for one to two weeks during healing.

SURGERY ON THE BREAST

Simple Mastectomy

Definition.—Removal of a breast without axillary dissection.

Purpose.—To prevent or control a cancerous lesion.[14, 15, 25, 35]

Setup, Position, Skin Preparation, and Draping Procedure.—The setup includes the following:

Biopsy Setup

1 Portable Mayo stand cover
6 Towels
1 Fenestrated sheet
12 Gauze sponges
1 Glove set
1 Gown set
1 Minor basin set
1 Scalpel
1 Scissors
2 Tissue forceps with teeth
1 Tissue forceps without teeth
3 Allis forceps
4 Kelly hemostats, curved
6 Crile hemostats, straight
Chromic gut No. 4-0
Skin sutures
Needle holder
Electrosurgical unit with knife electrode

Also

Setup for basic celiotomy (Chapter 11), plus extra hemostats

The patient is placed on the operating table in a supine position, with the affected arm extended on an armrest (Fig. 410). The proposed operative site is prepared (Chapter 3). The patient is draped with towels and a fenestrated sheet for the biopsy procedure. Following the biopsy, the patient is redraped with a fenestrated sheet for a simple mastectomy. Instruments used to perform the biopsy are discarded for cleansing and sterilization.

Operative Procedure (Simple Mastectomy).—

Steps	*Items*
1. Through a transverse elliptical incision, the skin edges are freed from the fascia and bleeding vessels are clamped and ligated.	1. Scalpel, tissue forceps, sponges, Kelly or Crile hemostats, plain or chromic gut No. 3-0 or 4-0 or silk No. 4-0, scissors
2. Skin edges of the wound are protected; the breast tissue is grasped and dissected free from the underlying fascia. The tumor is removed.	2. Small surgical towels or gauze compresses, Allis forceps, Crile or Mayo-Pean hemostats, dissecting scissors, electrosurgical unit, basin for specimen, ligatures

Steps	*Items*
3. A drain may be inserted and anchored to the skin with a suture. The wound is closed and dressings are applied.	3. Penrose drain, plain or chromic gut No. 3-0 swaged-on ½-circle intestinal needle, needle holder, silk or nylon No. 4-0 skin needles, and dressings

Biopsy and Radical Mastectomy

Definition.—Removal of tissue for biopsy and closure of wound; then removal of the entire breast, axillary contents, and portions of the pectoralis minor and major muscles and rectus sheath.

Purpose.—To control the spread of cancerous lesions.[14, 15, 24, 35]

Setup, Position, Skin Preparation, and Draping Procedure.—Basic abdominal celiotomy setup (Chapter 11), adding the following:

Sutures

3 Regular surgeon's needles No. 4, cutting-edge ⅜-circle
2 Regular surgeon's needles No. 10, cutting-edge ⅜-circle
3 Keith abdominal straight needles, 2 inches
2 Murphy ½-circle, taper-point No. 4 needles
2 Mayo ½-circle taper-point No. 3 needles
Plain gut No. 2-0
Chromic gut Nos. 2-0, 3-0, and 0
Silk Nos. 4-0, 3-0, and 2-0



Fig 410—The position of the patient on the operating table when the surgeon is to perform a radical mastectomy The arm is extended on a padded armrest which is positioned at a 45-degree angle The arm often is secured with a loose-fitting wide cotton strap on a padded armrest which is at a 45-degree angle from the body The upper half of the table is slightly inclined upward and the table as a whole is tilted horizontally away from the operator so as to make the lateral aspect of the breast more accessible. (From Haagensen, C D.: Diseases of the Breast, Philadelphia, 1956, W. B. Saunders Co)

Nylon suture No. 5-0 or 6-0
Swaged-on sutures used whenever possible

Extra Sterile Textiles

1 Gown set
1 Glove set
1 Biopsy setup
1 Radical mastectomy pack
  25 Sponges for holders
  50 Gauze sponges, 4 by 4 inches
  25 peanut sponges
  6 Gauze sponges, 4 by 8 inches
  3 Fluffed gauze dressings
  2 Topper pads
  2 Bandages, 2½ inches wide, if desired
12 Laparotomy pads
1 Radical breast sheet with left or right opening, tray cover, and small sheet, or 2 large regular sheets, 1 small sheet, and 1 tray cover
Skin grafting set, if requested

The patient is placed on the table in a supine position, with the affected arm extended on the armrest (Fig. 412). The operative site is cleansed with a detergent or soap and water, and painted with a germicide (Chapter 3). The patient is draped with a small sheet and a fenestrated sheet for the biopsy procedure. After completion of the biopsy, the instruments and draping sheets are removed. The scrubbed nurse and operators put on fresh gowns and gloves.

The proposed operative site is repainted and surrounded with four towels. The affected arm is encased in a tray cover or pillowcase (Figs. 411 and 412) and the patient is draped, using a fenestrated sheet with an opening of sufficient size to expose the entire gland and axillary region. The fenestrated sheet is folded and opened over the patient as described for the use of a laparotomy sheet (Chapter



Fig 411 —Radical mastectomy draperies First step The operative field, including the arm, has been cleansed and side of the patient draped with table pad The tray cover is draped over arm without touching the skin of the patient. Notice the deep cuff on the tray cover



Fig 412 —Radical mastectomy draperies—cont'd Second step. The tray cover is brought over the extremity, completely covering the armboard. Notice the gloved hands of the nurse are under a narrow cuff of the upper fold of the tray cover.



Fig 413 —Radical mastectomy draperies—cont'd Final step Showing the placement of upper sheet and towel forceps

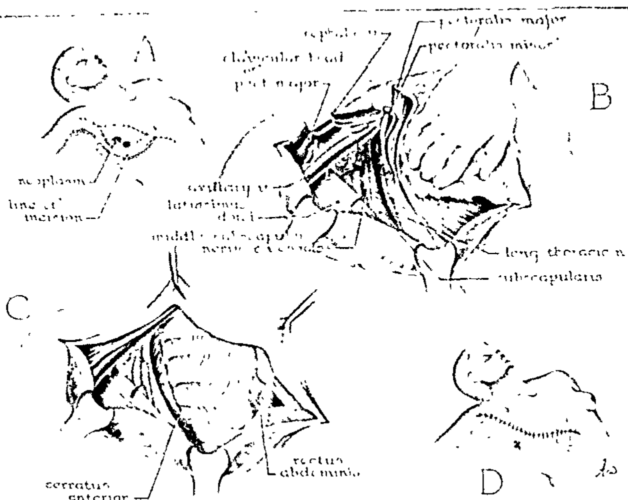


Fig. 414.—Radical mastectomy. (From Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co.)

4). Rather than the fenestrated sheet, regular sheets, as illustrated in Fig. 413, may be draped over the patient.

To prevent the spread of cancer cells during the operation, the soiled hemostats are discarded in a basin on the sterile field. These instruments are resterilized during the operation. When a skin grafting procedure is to be performed, a separate setup will be needed for taking the graft from the donor site.

Operative Procedure.—The steps, as shown in Fig. 414, include the following:

Steps	*Items*
1. A skin incision is made down through the fat to the muscle. The bleeding points are controlled (Fig. 414).	1. Gauze, sponges, scalpel, tissue forceps, Crile hemostats, Lahey forceps, ligatures plain No. 2-0 or silk No. 4-0, 8 inches
2. The skin is undercut in all directions to the limits of the dissection.	2. Clean knife, curved scissors, tissue forceps, basin for discarded instruments

Steps	*Items*
3. The margins of the skin flaps are covered with moist warm pads.	3. Two laparotomy pads or skin towels, towel forceps, tissue forceps, Roux retractors, warm moist pads
4. The pectoralis major muscle at the point of insertion into the humerus is freed and divided (Fig. 414).	4. Scalpel, gauze sponges, Crile hemostats, Mayo-Pean hemostats, ligatures chromic gut No. 0 or silk or nylon, No. 2-0, straight scissors
5. The vessels and nerves of the pectoralis major and minor muscles are dissected, clamped, and divided.	5. Blunt dissection, curved scissors, tissue forceps, suture ligature, chromic gut 0 or silk No. 2-0 or 3-0 threaded on a Murphy needle No 2, ligatures, 12 inches
6. The cut end of the pectoralis major is grasped and retracted medially. The attachment of this muscle to the clavicle is exposed and cut.	6. Billroth or Richardson retractors, Lahey forceps, warm pads, Mayo-Pean hemostats, scalpel
7. Then the pectoralis minor muscle is exposed and cut close to its insertion into the coracoid process and retracted downward.	7. Roux retractor, Mayo-Pean hemostats, knife, ligatures, chromic gut No. 2-0 or silk No. 2-0, warm moist pads
8. The axillary tissue is dissected, the vessels are identified, and tissues above and below the axillary vessels are dissected away.	8. Curved scissors, tissue forceps, Crile hemostats, gauze sponges, ligatures chromic gut No. 2-0 or silk No. 3-0
9. The fascia overlying the anterior sheath of rectus abdominis muscle is dissected free from chest wall.	9. Laparotomy pads, scalpel, tissue forceps, basin for specimen, Crile and Mayo-Pean hemostats
10. All bleeding points are clamped and ligated. The wound is cleaned.	10. Warm moist pads, Crile hemostats, ligatures, chromic gut No. 2-0 or silk No. 3-0, straight scissors, clean towels.
11. The skin edges are brought together.	11. Allis forceps
12. If drainage is desired an opening is made in the skin, usually through the lateral flap in the axillary region.	12. Scalpel, retractors, ligatures, Penrose drain, rubber tubing, or silk No. 4-0, threaded on straight skin needle, tissue forceps
13. The skin edges are approximated. Silver foil may be applied to the suture line (Fig 414).	13 Interrupted suture of silk No. 4-0, nylon No. 5-0, or wire No. 6-0 threaded on straight skin needle, skin forceps, skin hooks
14. Dressings are applied to the wound, and fluff gauze is inserted into the axilla, beneath the clavicle and around the drain A breast binder is applied	14 Fluff gauze, 6 pieces of 4 by 8 inch compresses, 1 Dakin or cotton pad, binder, safety pins

REFERENCES

1. Anthony, Catherine P.: Textbook of Anatomy and Physiology, ed. 4, St. Louis, 1955, The C. V. Mosby Co.
2. Callander, C. L.: Surgical Anatomy, ed. 11, Philadelphia, 1952, W. B. Saunders Co.
3. Ciba Foundation: Major Anatomy of the Female Genital Tract, Boston, 1948, Little, Brown & Co.
4. Curtis, A., and Huffman, J.: A Textbook of Gynecology, Philadelphia, 1950, W. B. Saunders Co.
5. Greenhill, J. P.: A Handbook of Surgical Gynecology Including Important Obstetric Operations, ed. 2, Chicago, 1957, The Year Book Publishers, Inc.
6. Krantz, K. E.: Urethra: Anatomy and Histology of Urethra and Anterior Vaginal Wall, Am. J. Obst. & Gynec. 62:374, 1951.
7. Novak, E., and Novak, E. R.: Textbook of Gynecology, ed. 5, Baltimore, 1956, Williams & Wilkins Co.
8. Te Linde, R. W.: Operative Gynecology, ed. 2, Philadelphia, 1953, J. B. Lippincott Co.
9. Schauffer, C.: Pediatric Gynecology, ed. 3, Chicago, 1956, Year Book Publishers, Inc.
10. Crossen, H. S.: Diseases of Women, ed. 3, St. Louis, 1953, The C. V. Mosby Co.
11. Cameron, C. S.: The Truth About Cancer, Englewood Cliffs, N. J., 1956, Prentice-Hall, Inc.
12. Baird, D.: Combined Textbook of Obstetrics and Gynecology for Students and Practitioners, Baltimore, 1950, Williams & Wilkins Co.
13. Ciba Foundation: Major Anatomy and Pathology of the Breast, Summit, N. J., 1947, Ciba Pharmaceutical Products, Inc.
14. Haagensen, C. D.: Diseases of the Breast, Philadelphia, 1956, W. B. Saunders Co., chaps. 19, 20, 27.
15. MacDonald, J.: The Breast; in Christopher, F.: Textbook of Surgery, Philadelphia, 1956, W. B. Saunders Co., chap. 12.
16. Hunter, R. G., and others: Postoperative Backache Following Use of the Lithotomy Position, Am. J. Obst. & Gynec. 4:344, 1954.
17. Parsons, L. and Ulfelder, H.: An Atlas of Pelvic Operations, Philadelphia, 1953, W. B. Saunders Co.
18. Positioning the Patient for Surgery. ANA-NLN Film Committee, 1957, ANA Film Service, 2 Park Ave., New York 17, N. Y.
19. Berkeley, Sir C., and Bonney, V.: Textbook of Gynecological Surgery, ed. 5, New York, 1949, Paul B. Hoeber, Inc.
20. Lowrie, R. J.: Gynecology: Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.
21. Miller, A.: Gynecology and Gynecologic Nursing, Am. J. Nursing 55:43, 1955.
22. Eldridge, E.: Surgical Nursing, ed. 10, Philadelphia, 1955, J. B. Lippincott Co.
23. Crossen, R. J., and Campbell, A. J.: Gynecologic Nursing, ed. 5, St. Louis, 1956, The C. V. Mosby Co.
24. Moseley, R.: Textbook of Surgery, ed. 2, St. Louis, 1955, The C. V. Mosby Co.
25. Ochsner, A., DeBakey, M. E., and others: Christopher's Minor Surgery, ed. 7, Philadelphia, 1955, W. B. Saunders Co., chaps. 2, 4, 19.
26. Rubin, I. C., and Novak, J.: Integrated Gynecology, Principles and Practices, New York, 1956 McGraw-Hill Book Co. Inc., vols. 1, 2, 3.
27. Schaefer, G.: Tuberculosis in Obstetrics and Gynecology, Boston, 1956, Little, Brown, & Co.
28. Titus, P., and Willson, J. R.: The Management of Obstetric Difficulties, ed. 5, St. Louis, 1955, The C. V. Mosby Co.
29. Meaker, S. R.: A Doctor Talks to Women, New York, 1954, Simon & Schuster.
30. Counseller, V. S.: Vaginal Hysterectomy by Ligature Method, and Correction of Cystourethrocele, in Lowrie, R. J.: Gynecology, Surgical Techniques, Springfield, Ill., 1955, Charles C Thomas, Publisher.
31. Christopher, F.: Textbook of Surgery, ed. 6, Davis, Loyal (ed.), Philadelphia, 1956, W. B. Saunders Co.

Steps	*Items*
3. The margins of the skin flaps are covered with moist warm pads.	3. Two laparotomy pads or skin towels, towel forceps, tissue forceps, Roux retractors, warm moist pads
4. The pectoralis major muscle at the point of insertion into the humerus is freed and divided (Fig. 414).	4. Scalpel, gauze sponges, Crile hemostats, Mayo-Pean hemostats, ligatures chromic gut No. 0 or silk or nylon, No. 2-0, straight scissors
5. The vessels and nerves of the pectoralis major and minor muscles are dissected, clamped, and divided.	5. Blunt dissection, curved scissors, tissue forceps, suture ligature, chromic gut 0 or silk No. 2-0 or 3-0 threaded on a Murphy needle No. 2, ligatures, 12 inches
6. The cut end of the pectoralis major is grasped and retracted medially. The attachment of this muscle to the clavicle is exposed and cut.	6. Billroth or Richardson retractors, Lahey forceps, warm pads, Mayo-Pean hemostats, scalpel
7. Then the pectoralis minor muscle is exposed and cut close to its insertion into the coracoid process and retracted downward.	7. Roux retractor, Mayo-Pean hemostats, knife, ligatures, chromic gut No 2-0 or silk No. 2-0, warm moist pads
8. The axillary tissue is dissected, the vessels are identified, and tissues above and below the axillary vessels are dissected away.	8. Curved scissors, tissue forceps, Crile hemostats, gauze sponges, ligatures chromic gut No. 2-0 or silk No. 3-0
9. The fascia overlying the anterior sheath of rectus abdominis muscle is dissected free from chest wall.	9. Laparotomy pads, scalpel, tissue forceps, basin for specimen, Crile and Mayo-Pean hemostats
10. All bleeding points are clamped and ligated. The wound is cleaned.	10. Warm moist pads, Crile hemostats, ligatures, chromic gut No 2-0 or silk No. 3-0, straight scissors, clean towels
11. The skin edges are brought together.	11. Allis forceps
12. If drainage is desired an opening is made in the skin, usually through the lateral flap in the axillary region.	12 Scalpel, retractors, ligatures, Penrose drain, rubber tubing, or silk No 4-0, threaded on straight skin needle, tissue forceps
13 The skin edges are approximated. Silver foil may be applied to the suture line (Fig 414).	13. Interrupted suture of silk No. 4-0, nylon No 5-0, or wire No. 6-0 threaded on straight skin needle, skin forceps, skin hooks
14. Dressings are applied to the wound, and fluff gauze is inserted into the axilla, beneath the clavicle and around the drain A breast binder is applied.	14. Fluff gauze, 6 pieces of 4 by 8 inch compresses, 1 Dakin or cotton pad, binder, safety pins

CHAPTER 16

OPERATIONS ON THE GENITOURINARY ORGANS

ANATOMY AND PHYSIOLOGY OF THE GENITOURINARY TRACT

The normal urinary organs in the male or female comprise two kidneys which secrete the urine; two ureters or ducts which convey urine to the bladder, where it is retained for a time; and a urethra through which the urine is discharged from the body.[1-4] In the male, the sex organs include the external genitals and the associated glands and ducts. These organs have a direct or indirect function in the process of procreation. The sex organs in the female are described in Chapter 15.

The Kidneys.—The kidneys are situated in the posterior part of the abdomen on either side of the vertebral column, behind the peritoneum (outside the peritoneal cavity). They are surrounded by a mass of fat and loose areolar tissue.

The kidneys are protected by the thoracic cage. Their upper poles overlie the twelfth thoracic vertebra, and their lower poles extend to the third lumbar vertebras. The kidneys are bean-shaped, and their convex borders point laterally, while their concave borders are turned toward the spinal column. They are separated from the vertebras by the psoas major muscle.[5,9] The anterior and posterior relations of the kidney are shown in Fig. 416.

Each kidney is enclosed in a fibrous covering, called the capsule, and is protected by a layer of perirenal fat.[1,9] On the medial side of each kidney there is a concave notch, called the hilum, through which the arteries and veins enter and leave and at which site the renal pelvis is found. (Figs. 415 and 417.)

The kidney consists of two distinct layers. These include an outer portion, called the cortex, which contains the glomeruli and the functioning tubules, and an inner portion, called the medulla, which contains many collecting tubules and ducts.[1] The structures of the medulla are arranged in conical masses, and are known as renal pyramids (Fig. 417). They empty into the minor calyces which, in turn, empty into the major calyces. These, in turn, empty into the pelvis of each kidney which narrows to form the ureter.[10] It is about ten inches long and empties into the bladder.

The kidneys are very vascular since one fourth of the entire volume of blood passes through them at any one time. They receive their blood supply through the renal arteries which originate from the aorta. Each renal artery divides into several branches (afferent vessels), which at the hilum lie between the renal

32. Meigs, F V.: Surgical Treatment of Cancer: The Cervix, New York, 1954, Grune & Stratton, Inc.
33. Counseller, V. S.: Vaginal Hysterectomy: Indications, Advantages and Surgical Technics, Obst. & Gynec. 1:81, 1953.
34. Ranney, B.: Endometriosis, Am. J. Nursing 52:1465, 1952.
35. Lewison, E. F: Breast Cancer and Its Diagnosis and Treatment, Baltimore, 1956, Williams & Wilkins Co

Films*

Adair, F. E.: Cancer of the Female Breast.
Bergman, T.: Surgical Anatomy of the Female Perineum.
Meigs, J. V.: Total Abdominal Hysterectomy and Perineorrhaphy.
Schmitz, H.. Ovarian Tumors.
Curtis, A. H: Vaginal Repair.
Positioning the Patient for Surgery, ANA-NLN Film Committee, 1957.
Transporting the Patient for Surgery, ANA-NLN Film Committee, 1958.

*Surgical Film Library, Surgical Products Division, American Cyanamid Co, Danbury, Conn

vein and the kidney pelvis. They usually pass posterior to the kidney pelvis to enter the kidney substance. They leave the kidney as efferent vessels and pass along the tubules, joining to form the renal vein which empties into the inferior vena cava. Occasionally there may be aberrant vessels which may enter at either the upper or lower pole of the kidney.

The lymphatic supply, for the most part, drains into the lymph nodes that are located between the renal vessels and the aorta, and it accompanies the venous drainage (Fig. 416).

The nerves of the automatic system carry pain sensations and supply the blood vessels. The nerve supply to the kidney comes from the fourth to the twelfth thoracic segment and frequently from communications with the vagus and splanchnic nerves. Removal of the nervous pathways disrupts the ability to feel pain, without impairment of kidney function. (Fig. 418.)

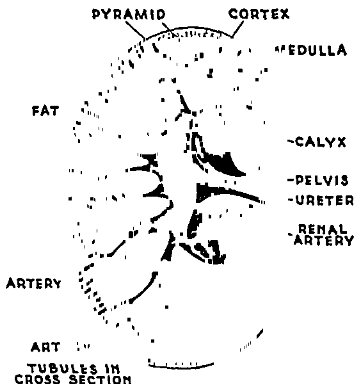


Fig 417—Cross section of kidney (After Tyson, from Zoethout, W D, and Tuttle, W W., Textbook of Physiology, St Louis, 1955, The C. V Mosby Co)

The Ureters.—The ureters are long tubes through which the urine passes from the renal pelvis to the bladder. The two ureters open into the bladder about 3 cm. apart They lie in the retroperitoneal space. The pelvic brim divides the ureters into two divisions—the upper abdominal portion and the lower pelvic portion

Normally there are three constrictions in each ureter in which stones may become lodged for varying periods. The ureter is composed of three layers: fibrous (outer), muscular (middle), and mucosal (inner). Arteries supplying the ureters are branches from the renal vessels above, the aorta (hypogastric branch), and the inferior vesicle vessels below.

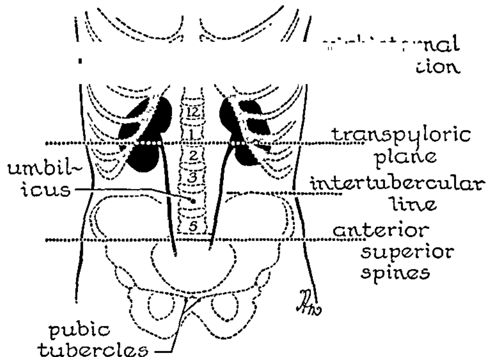


Fig 415 —Surface anatomy of kidneys. (From Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C V. Mosby Co)

Fig. 416.—Anterior and posterior relations of kidneys (From Moseley, H. F· Textbook of Surgery, St. Louis, 1955, The C. V Mosby Co)

When the bladder is empty it is triangular in shape; when full, it is globular. The size, position, and relation of the bladder to the intestines, rectum, and reproductive organs vary according to the amount of fluid it contains. In most normal cases the bladder will hold 350 ml. without undue discomfort. The process of emptying the bladder is initiated by the reflex centers of the brain which cause the voluntary urethral sphincter to relax (Chapter 6). The detrusor muscle of the bladder contracts, as well as the abdominal muscles, and when the bladder is empty the sphincter muscle contracts to close the urethra.

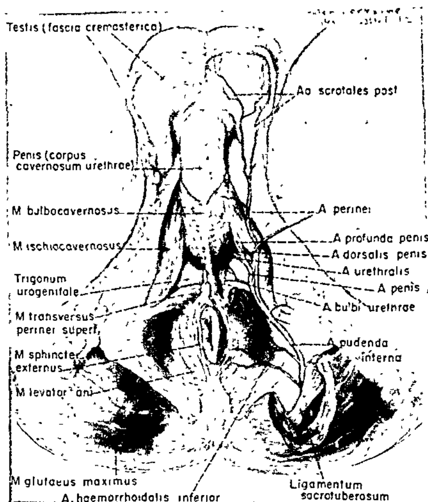


Fig 419—Anatomy of the perineum. (After Spalteholz, from Campbell, M: Urology, vol. I, Philadelphia, 1954, W. B. Saunders, Co)

In the male, the ejaculatory structure contracts, thereby forcing urine from the deep urethra.

The base of the bladder has a smooth surface, but the remainder of the wall is drawn into folds when the bladder is empty. It is connected to the pelvic wall by fascial attachments that extend from back of pubic bones to front of bladder Other muscular fibers also pass from fundus of bladder to sides of rectum.

The bladder is composed of four layers: serous, muscular, submucosal, and mucosal. The blood supply is derived from branches of the anterior trunk of the hypogastric artery.

The ureters act independently of each other.

Due to the peristaltic muscular contraction of the renal pelvis, the urine is forced to leave the kidney and is pushed through the ureters. As a result, the urine is expressed from the ureteral openings in a series of spurts, with a rest period of about eight or more seconds between the series.

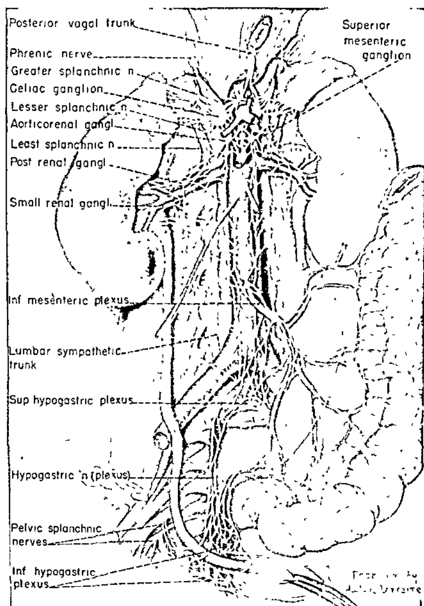


Fig. 418 —Nerve supply of kidneys, ureters, adrenal glands, and bladder (From Campbell, M: Urology, vol I, Philadelphia, 1954, W B Saunders Co)

The Urinary Bladder.—The urinary bladder is a musculomembranous sac situated in the pelvis behind, below the symphysis pubes, in front of the rectum, and above the prostate gland in the male and in front of the uterus and vagina in the female (Figs. 419 and 420) When the bladder becomes distended, it begins to ascend above the symphysis pubis, pushes its peritoneal covering ahead of it, and partially becomes an abdominal structure.

Within the scrotum there are two cavities or sacs which are lined with smooth and glistening tissue known as the tunica vaginalis. The scrotal sac contains the testicle.

The testicle is the male organ of reproduction that manufactures the spermatozoa and also contains a specialized cell (Leydig) that produces an internal secretion.

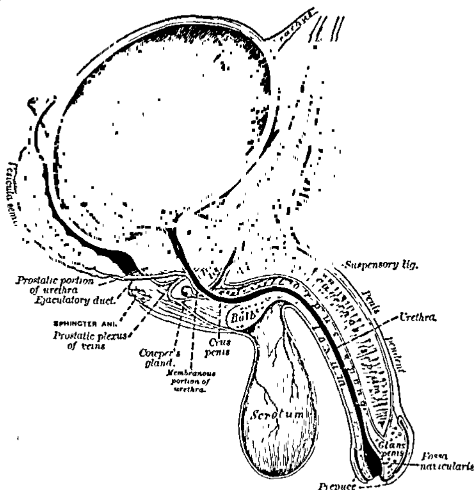


Fig 421 —Vertical section of bladder, penis, and urethra. (From Lewis; Gray's Anatomy, Philadelphia, Lea & Febiger.)

In the adult, the two testicles, one on each side, are located in the scrotum, lying free in the sac of the tunica vaginalis except for their attachment posteriorly. Before birth the testicles descend from the abdominal cavity, bringing with them the coverings of each abdominal layer that they penetrated. Just before birth the testicles are usually suspended at the bottom of the scrotum by the spermatic cord. If they remain in the abdominal cavity or inguinal canal, the patient's lesion is known as undescended testis or cryptorchidism.

The testicle consists of a firm dense capsule of connective tissue in which a mass of tubular glands becomes compressed, joins together, and passes out of the testis into the epididymis Between the tunica vaginalis (scrotal sac) and the capsule of the testis, there is a small quantity of fluid. But when an abnormal amount of fluid forms, the condition is called a hydrocele.

The Male Urethra.—The male urethra is a tube about 20 cm. in length which forms an S curve. It is the terminal portion of both the urinary and reproductive tracts.[11] In the posterior portion of the urethra the prostatic urethra passes through the prostate gland and the membranous portion which contains the external sphincter of the bladder. The anterior urethra has two distinct divisions: the bulbous urethra and the pendulous portion.

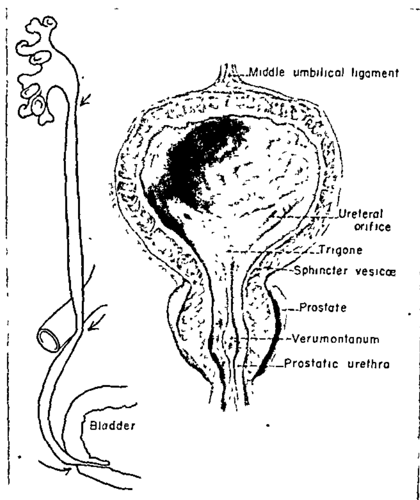


Fig 420—Bladder and prostate, sectioned to show structure of bladder wall and points of interest in base of bladder and posterior urethra Diagram showing normal areas of urethral constriction (From Campbell, M Urology, vol I, Philadelphia, 1954, W. B Saunders Co)

The Female Urethra.—The female urethra is about 7 cm. in length. When urine is passed the urethra becomes a hollow tube, when it is not in use, however, its walls collapse. This structure lies behind and beneath the symphysis pubis and in front of the vagina. The external urethral orifice (urinary meatus) opens anteriorly into the vaginal opening and lies behind the clitoris.

The Reproductive Male Organs.—The scrotum is located behind the base of the penis and in front of the anus. This loose sac provides a covering for the testicles. The two sides of the scrotum are separated from each other by a smooth area called the median raphe (Figs 421 and 422).

extends into the spermatic cord. Both the anterolateral and posterolateral surfaces of the epididymis are covered by the tunica vaginalis, leaving its posteromedial surface without a serosal covering.[12] The spermatozoa from the testicle pass through the epididymis to enter the vas deferens.

The vas deferens begins at the globus minor of the epididymis, continues upward as a part of the spermatic cord, and courses through the inguinal canal (Chapter 11). *The function of the vas deferens is to conduct the spermatozoa to the seminal vesicles.* The vas deferens enters the internal inguinal ring, crosses the ureter, passes around the posterior surface of the bladder, and joins the seminal vesicles. The vas deferens derives its blood supply from branches of the spermatic cord.

The seminal vesicle, *situated on either side, extends above the prostate gland* and behind the bladder (lateral portion). The seminal vesicles serve as a storage place for the testicular secretions until ejaculation occurs.

The ejaculatory ducts are structures which unite the seminal duct and the vas deferens on either side. The ejaculatory duct courses through the substance of the prostate gland and opens into the posterior urethra.

The prostate gland is an accessory sex organ. It lies just below the bladder and in front of the rectum and surrounds the prostatic portion of the urethra. It is about the size and shape of a chestnut and consists of five lobes. The ducts from the various prostatic lobes communicate with the posterior urethra by many openings (Fig. 422).

The entire prostate gland is surrounded by a fibrous covering called the prostatic capsule, through which the ejaculatory ducts enter and pass through the gland. Surrounding the prostatic capsule, there is a fibrous sheath of which the posterior portion is thickened to form the fascia of Denonvilliers. This fascial layer separates the prostate gland and the seminal vesicles from the rectum.

The smooth muscles of the prostate gland contract to empty the gland and ducts (Chapter 6). The lobes of the gland secrete a highly alkaline fluid that dilutes the testicular secretion as it comes from the ejaculatory ducts. The prostate gland receives its blood supply from the internal pudendal, inferior vesicle, and hemorrhoidal arteries.

The penis is a pendulous organ suspended by the fascial attachments of the pubic arch and supported by the suspensory ligaments (Fig. 421). The penis contains three distinct vascular spongelike bodies: the two upper bodies are called the right and left corpus cavernosum penis and the lower body, the corpus cavernosum urethra. The tissue with these bodies or compartments is known as erectile tissue, which, in turn, contains a loose network of veins that fill with blood on erection At the distal (free) end of the penis, the skin is folded doubly to form the so-called prepuce or foreskin, which serves as a covering for the glans penis.

PREVENTIVE MEASURES FOR OPEN GENITOURINARY SURGERY

The patient who undergoes an operation involving the genitourinary tract is subject to the complications which follow major surgery.[12-16] These compli-

The testicles derive their blood supply from the spermatic artery.

The spermatic cord on each side contains the vas deferens (the excretory duct of the testes), the spermatic artery, and a plexus of veins.[1] These veins unite to form several trunks within the inguinal canal, later to form two veins known as the internal spermatic veins, which enter the abdominal cavity. The right vein empties into the inferior vena cava and the left into the left renal vein. These structures, including the lymphatics, nerves, and surrounding connective tissue (cremaster muscle), make up the spermatic cord that passes through the inguinal canal and supports the testis as it lies in the scrotum.

The epididymis is a narrow tubular structure which originates on the porterior aspect of each testicle. The epididymis is divided into three parts: the upper pole of globus major, the corpus or body, and the globus minor or tail. The distal end of the epididymis is continuous with the vas deferens which

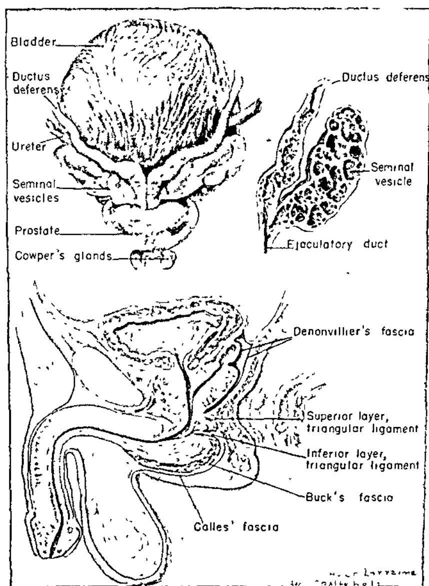


Fig. 422.—Relationship of bladder and genital structures (After Spalteholz, from Campbell, M: Urology, vol I, Philadelphia, 1954, W. B Saunders Co)

2 Greene retractors, optional
4 Knife handles—2 No. 4, 1 No. 3, 1 No. 3L; blades, Nos. 21, 10, and 15
3 Tissue forceps with teeth—2, 5½ inches; 1, 8 inches
3 Dressing forceps—2, 5½ inches; 1, 8 inches
5 Scissors—2 curved, 5½ inches; 1 *curved, 6¾ inches; 1 straight,* Mayo type, 5½ inches; 1 curved, Mayo-Harrington, 8 inches
4 Needle holders—2 Mayo-Hegar type, 7 inches; 1 Holick, Gross, *Diamond, or Masson, 8 or 10* inches; 1 Crile-Wood, 6 inches
16 Backhaus or Roeder towel clamps, 5¼ inches
6 Foerster or Robert sponge holders, *curved, serrated, 9 inches*
24 Crile hemostats, straight, 5½ inches
4 Allis forceps, 6 teeth, 7½ inches
2 Babcock forceps, straight, 7¾ inches
12 Rochester-Pean hemostats, curved, 6¼ inches
2 Stille vessel kidney or Mayo clamps, 9 inches (Fig. 423)
2 Rochester-Carmalt clamps, curved, 8 inches
2 *Herrick kidney clamps, 9 inches,* or Ockerblad clamp with jaws 2¾ inches and 8½ inches over-all length (Fig. 423)

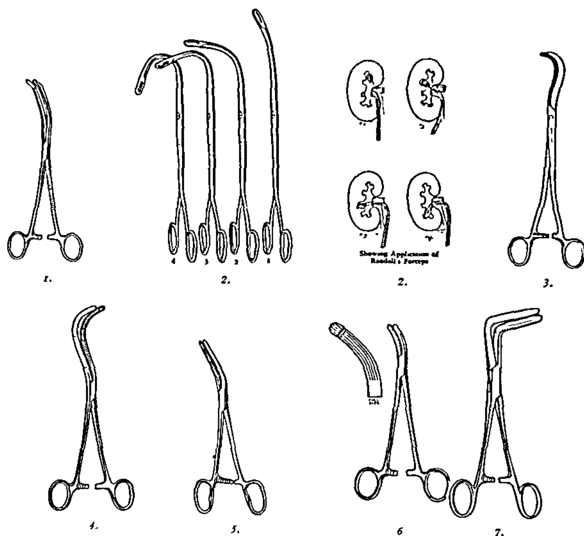


Fig 423—Instruments for open surgery on the kidney and ureter: *1,* Herrick kidney clamp; *2,* various types of Randall kidney stone forceps and their application; *3,* Stille vessel or kidney clamp; *4,* Mayo or Guyon kidney clamp, *5,* Ockerblad kidney clamp; *6,* Wertheim-Reverdin clamp; *7,* Wertheim Cullen pedicle clamp The instruments as shown are one third actual size. (Courtesy Codman & Shurtleff, Inc , Boston, Mass)

cations include cardiac failure, bronchitis, atelectasis, acute gastric dilation, paralytic ileus, hemorrhage, and shock (Chapter 4).

In positioning the patient on the operating table, the team should follow the adopted procedure. The position used should not interfere with normal systemic and pulmonary circulations or cause undue strain on the muscles and nerves. To ensure a clean postoperative wound and provide for adequate exposure of the proposed operative site, the skin surface must be prepared properly and the patient draped with sterile towels and an adequate fenestrated sheet. Whole blood, 5 per cent dextrose, and normal saline solution are needed to replace blood and fluid loss.

When the pleural cavity is opened, the accumulated air in the chest may be removed with a syringe attached to an aspirating needle or with pneumothorax apparatus (Chapter 9). If the gastrointestinal tract is opened, the standard technique for an anastomosis is followed (Chapter 12). Moist pads are used to wall off a contaminated region or organ, and a suction apparatus is used to remove the serum, blood, or necrotic tissue. A sponge count is taken before the wound is closed (Chapter 4).

A bladder drainage tube or catheter must be fairly stiff so that it will not collapse in the wound. An angulated tube or catheter may be used to prevent kinking due to pressure from the dressings. When a straight tube is inserted into the wound, the free end may be cut off at a level with the skin and attached to a right-angled connecting tube.

When an electrosurgical unit is used, necessary precautions should be taken to eliminate explosion hazards, to protect the patient from burns, and to protect the surrounding tissues when the machine is being used. The team should follow the safety rules recommended by the National Fire Protection Association (Chapter 2).

In caring for urological instruments, urethral catheters, filiforms, followers, and bougies, the worker should carry out the method described in the procedure book (Chapter 2).

OPEN SURGERY ON THE KIDNEY AND THE URETER

The basic setup, including instruments, sutures, drains, catheters, linen goods, and other items, should be adequate to meet the surgeons' preferences and suitable to the structures involved. Standard setups should be approved and evaluated at periodic intervals by the attending physicians and head nurses on the service. The surgeon who will need special equipment should request, in writing, additional equipment when he reserves the operating room unit for the patient.

Basic Setup

The items include the following:

2 Richardson or Israel retractors, blades 1½ inches
1 Kelly rectractor
3 Deaver retractors, desired width
1 Malleable retractor
2 Roux or Parker retractors

Sutures

Mild or medium chromic surgical gut Nos. 3-0, 2-0, 0, and 1
Plain surgical gut No. 0, if desired
Surgical silk Nos. 0, 2-0, and 3-0
Tension sutures, nylon No. 1 or silk No. 3
Skin sutures, metal clips and holders, silk No. 4-0 or nylon No. 3-0

Sterile Dry Goods and Solutions

Major linen pack (Chapter 2)
Laparotomy pack
Gown pack
Glove set
Basin set
Extra gauze sponges
Laparotomy pads (Chapter 4)
Infusion and transfusion sets
Parenteral solutions
Cardiac arrest setup, including sponges, needles, and drugs

Other Items

Attachments and supports for operating table
Infusion standard
Portable standard
Tables for storing sterile equipment

Setups for Different Types of Operations on the Kidney

Nephrectomy.—Basic setup for open surgery on the kidney.

Heminephrectomy.—Basic setup for open surgery on the kidney.

Nephropexy.—Basic setup for open surgery on the kidney, omitting kidney clamps and scoops, adding chromic ribbon gut for Lowsley operation.

Nephrotomy and Nephrolithotomy.—Basic setup for open surgery on the kidney, omitting kidney clamps, adding Doyen or Scudder intestinal forceps with rubber guards, if desired.

Nephrostomy.—Basic setup for open surgery on the kidney, omitting kidney clamps, adding the following:

1 Pezzer or Malecot catheter No. 16 or 18 F
1 Ureteral flexible probe
2 Mayo duct scoops
3 Judd-Allis forceps
2 Kimball nephrostomy hooks
4 Randall kidney stone forceps
1 Cummings or Kimball nephrostomy tube, or Foley catheter No. 16 or 18 F with 5 ml. beg (Fig. 424)
1 Asepto syringe
1 Soft rubber tube drain or cigarette drain
2 Chromic gut sutures No. 2-0 or 3-0 swaged-on ½-circle intestinal needles
2 Plastic tissue forceps
1 Mayo-Harrington or Metzenbaum scissors

Pyelotomy.—As listed for nephrolithotomy and nephrostomy.

Pyelostomy.—As listed for nephrostomy.

Pyeloplasty Operations (Ureteropyelostomy or Ureteroplasty).—As listed for pyelolithotomy and nephrostomy.

Incision and Drainage of Kidney or Perinephritic Abscess.—Basic setup for open surgery on the kidney, omitting kidney and stone forceps.

Division of Isthmus of a Horseshoe Kidney.—Basic setup for open surgery on the kidney, including long-bladed pedicle clamps and drainage tubes.

Division of Aberrant Renal Vessels.—Basic setup for open surgery on the kidney.

Denervation and Decapsulation of the Kidney.—Basic setup for open surgery on the kidney, omitting kidney clamps, adding nerve hooks, long tissue forceps, and scissors for nerve dissection (Chapter 6).

1 Urethral guide, flexible
2 Urethral bougies No. 7 and 9 F, optional
Skin clips or auto clips and holders, if desired
1 Needle, gauge 18, 3 inches
1 30 ml. syringe
1 Abdominal suction tube and piece of rubber tubing
Electrosurgical unit, optional

For Rib Resection

1 Alexander-Farabeuf costal periosteotome (Chapter 9)
1 Doyen or Matson rib stripper
1 Semb shears, angled, 10½ inches
1 Stille-Luer rongeur

Drainage Set

Penrose drain, ⅝ inches in diameter and 12 inches long (Chapter 11)
Plain packing, 2 inches wide, 18 inches long
Black rubber tubing, ⅜ inch in diameter, 12 inches long
1 Urethral catheter No. 16 or 20 F
1 Pezzer or Malecot catheter No. 18 or 20 F, with mandarin

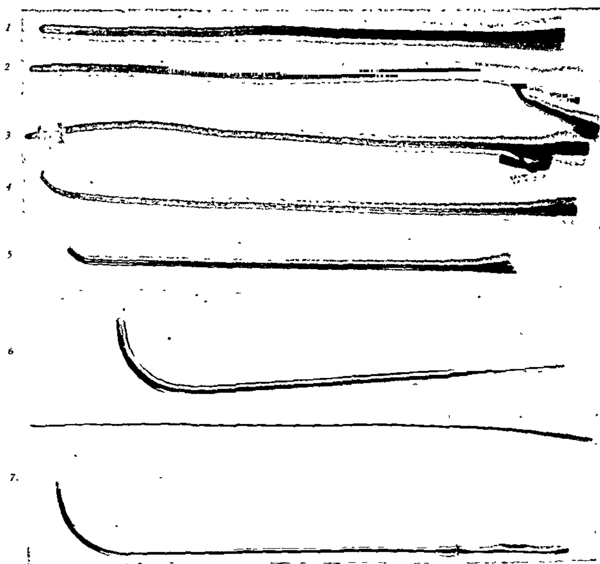


Fig 424.—*1*, Robinson catheter. *2*, Foley catheter, before and after inflation; *3*, coudé tip. *4*, Tiemann tip; *5*, Van Buren sound. *6*, filiform guide; *7*, filiform follower. (From Richards, V., Surgery for General Practice, St Louis, 1956, The C V. Mosby Co)

Ureterosigmoidostomy.—As listed for ureterointestinal anastomosis.

Cutaneous Ureterostomy.—As listed for ureterostomy.

Adrenalectomy.—Basic setup for open surgery on the kidney, adding the following:

2 Young retractors
Extra hemostats and skin instruments

Positioning the Patient for Open Surgery on the Kidney and Ureter

The surgeon and anesthesiologist determine the position to be used. The selection of a position depends on the type of incision to be made, the type of anesthesia to be used, the age and physical condition of the patient, and the presence of skeletal deformities or other diseases (Chapter 4).

To prevent postoperative complications due to malposition, the operating team carry out safety measures which provide for proper body alignment and functioning (Chapter 4).

Lateral Position

To perform open surgery on the kidney or ureter, the patient is usually placed on the operating table in a lateral (side-lying) position. To stabilize the patient a support or appliance is used. In some hospitals a special arm appliance is attached to the operating table and the upper extremities are secured to the splints. If a double arm restraint is not available, a portable standard may be used.

Equipment.—For the adult patient the supports include the following:

1 Small pillow
1 Large pillow encased in plastic cover
1 Support, made of sponge rubber, 5 inches thick, 5 inches wide, and 12 inches long
1 Metal kidney brace with padding
1 Single or double arm support
1 Adhesive strip, 3 by 18 inches, or a rubber explosion-proof strap
1 Leg strap, explosion-proof rubber material, clip-on or buckle type
1 Anesthetist's screen

For the child or infant the supports should include the following:

1 Oblong sponge-rubber support
1 Sponge-rubber roll, desired diameter
2 Small pillows
Baby board, if desired
Absorbent cotton for padding
Bandage, suitable width

Steps of Procedure.—The patient is admitted to the unit according to the plan adopted by the department. The nursing personnel who are assigned to assist the surgeons and anesthesiologist have the equipment and the operating table outside the operating room unit. The steps include the following.

1. Greet the patient by name and introduce self if he is awake.

2. Place the patient on the operating table in a supine position, with the iliac crest over the kidney elevator (rack) or over the center break of the table; fasten the leg strap around the table and over the thighs; take the patient into the operating room unit.

Setups for Different Types of Operations on the Ureter

Ureterolithotomy.—Basic setup for open surgery on the kidney and ureter, adding the following:

1 Blake stone forceps, curved, 8¼ inches (Chapter 13)
1 Mixter gallstone forceps, angular jaw, 6½ inches
1 Desjardin gallstone forceps, 9¼ inches
2 Gall duct malleable spoons, small size
2 Ratcliff-Mayo gall duct forceps, 8¾ inches, if desired
4 Randall stone forceps
1 Ureteral flexible guide
2 Lower gall duct forceps, longitudinal serrations, 7 inches
4 Babcock forceps, 7¼ inches
1 Asepto syringe, 2 ounces
1 Malecot catheter, 2- or 4-winged, No. 20 or 22 F
1 Pezzer catheter No. 18 or 20 F
1 Urethral catheter No. 12, 20, or 22 F
1 Ureteral bougie No. 7 or 8 F

Ureterotomy and Ureterostomy.—Basic setup for open surgery on the kidney and ureter, adding the following:

2 Adson tissue forceps with teeth
2 Plastic tissue forceps without teeth
1 Penrose drain or umbilical cotton tape
1 Metzenbaum scissors (Chapter 4)
1 Urethral, nylon, plastic, or rubber catheter No. 10, 12, or 14 F
1 Foley catheter No. 14 or 16 F with 5 ml. bag (Fig. 424)
1 Asepto syringe

Ureterectomy.—As listed for ureterostomy.

Ureteroplasty.—As listed for pyeloplasty.

Ureterointestinal Anastomosis.—Basic setup for open surgery on the kidney and ureter, adding the following:

1 Balfour self-retaining rectractor, optional
3 Halsted hemostats, curved, 5½ inches
3 Halsted hemostats, straight, 5½ inches
4 Adson hemostats, straight, 7¼ inches
1 Adson or Potts-Smith tissue forceps
4 Overholt forceps, fine points, angular jaws
2 Babcock forceps, 6¼ inches
4 Judd-Allis forceps, 7¼ inches
4 Murphy-Pean forceps, 6¼ inches, optional
1 Mayo or Mansfield isolation forceps, optional
1 Mayo ureteral knife or long scalpel with small blade
1 Ureteral guide, flexible
2 Thomas-Smith intestinal forceps with rubber guards, optional
1 Grooved director, long
1 30 ml. syringe
Fulguration machine and electrodes, optional
Extra gown and glove sets
2 Urethral catheters Nos. 12 and 16 F
1 Penrose drain, ⅝ inch wide, 18 inches long
1 Rectal catheter, No. 28 F
For bilateral procedure:
Extra dissection instruments and draping sheets

Ureteroureteral Anastomosis.—As listed for ureterointestinal anastomosis.

Ureteral Reimplantation.—Basic setup for open surgery on the bladder, adding special instruments listed for ureterointestinal anastomosis.

Ureterocystostomy.—As listed for ureteral reimplantation.

shoulder. If an arm support is not used, place a sponge-rubber pad under the uppermost arm. Attach the anesthetist's screen to the table. If a double arm appliance is used, extend the arms on the padded splints, keeping the body in good alignment.

7. Flex the underknee and bring the foot toward the buttock. Straighten the uppermost leg; then place a large pillow between the legs, and support the underfoot with a small pad to prevent plantar flexion. Fasten the leg strap to the table so that it rests over the thighs. Make sure the strap is not too tight. (Chapter 4.)

8. Attach a padded metal brace to the end of the kidney elevator near his back; slide the brace along the rack so that it stabilizes the back (Chapter 4).

9. If desired, attach a short metal brace to the other end of the kidney rack; slide the brace along the rack to support the abdomen, making sure that the folds of skin are not protruding over the rack. When a small sandbag or oblong support is used rather than the brace, secure the support in the lift sheet. A support is necessary to relieve muscle strain and abdominal weight which tend to pull the patient forward.

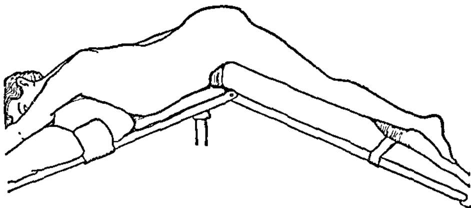


Fig. 426.—Position of the patient on the operating table for simultaneous exposure of the adrenal glands. The chest region on each side should be elevated with supports to provide for adequate respiratory function and the feet should be supported with pads to prevent plantar flexion. The lower extremities should not be lowered more than 20 degrees. (From Dodson, A. I.: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

10. Break the table slightly to widen the iliocostal region and to make the upperside a horizontal straight line. If the patient has a long twelfth rib, much adipose tissue, or well-developed back muscles, elevate the kidney rack slightly to curve the body. Adjust the height of the table to suit the operator's convenience.

11. Place a three-inch strip of adhesive or strap across the upper hip, and fasten it to the edge of the table on either side. This support prevents the torso from tipping forward or backward. Make sure the strap is loose enough to permit circulatory function. Focus the lamp over the proposed incisional site.

Other Types of Positions

In some cases the patient with an injury in which intra-abdominal and renal damage is suspected may be placed on the operating table in a supine position (Chapter 4).

3. Stay with the patient, and gently hold his hands until he has been anesthetized; then remove the leg strap (Fig. 425).

4. Turn him on his unaffected side, with the back and buttock near the edge of the table and the crest of the ilium directly over the kidney elevator. If a kidney elevator is not used, place a small oblong support beneath the iliac region.

5. Bring the underneath arm fairly free from the body to prevent pressure and keep him from falling forward. Place a sponge-rubber support beneath the axillary region to relieve pressure on the brachial plexus; then slightly flex the underneath elbow and position the arm on the support. Make sure the hips are in good alignment and the back is vertical and at a right angle to the table. If necessary, support the underbuttock with a small pad to prevent him from slipping backward.

6. To keep the shoulders vertical and relieve pressure and strain, slightly flex the uppermost elbow and place the arm on a special armrest attached to the table or on a small padded portable stand which has been brought over the upper chest region and adjusted at a height level with the uppermost

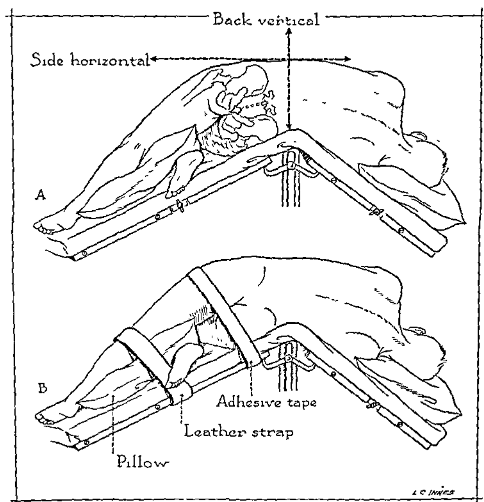


Fig. 425.—Position of the patient on the operating table for open surgery on the kidney and ureter. (From Barnes, R. W., and Hadley, H. L.: Urological Practice, St. Louis, 1954, The C. V. Mosby Co.)

The hockey-stick incision extends from the costovertebral angle across the thorax and the rectus sheath medially.

The transperitoneal or retroperitoneal incision is made in the epigastric and umbilical region (Chapter 11). This approach may be used to remove a large kidney tumor or to explore the abdominal cavity.

Skin Preparation and Draping Procedure for Open Surgery on the Kidney and Ureter

The proposed operative area is scrubbed with soap and water, or a synthetic disinfectant, and painted with a germicide. The principles of skin disinfection and the steps of the procedure are described and illustrated in Chapter 3. The operative site is surrounded by surgical towels, and the patient is draped with a fenestrated sheet in which there is a window sufficient for exposure of the operative site (Chapter 4). The folded sterile sheet is handled similar to the procedure described and illustrated for handling a laparotomy sheet (Chapter 4).

When a lumbar or S-shaped incision is to be made, the skin area to be prepared includes the anterior upper right or left chest region, the umbilical region, and the lumbar, iliac, and hypogastric region on the affected side.

Four towels are placed around the proposed incisional site. The turned-back cuff of each towel is placed on the prepared skin area. The first towel is placed transversely just above the affected hip and the lower abdomen; the second towel is placed parallel to the first towel and over the scapula and upper chest region; the third towel is placed longitudinally over the posterior lumbar region; the fourth towel is placed along the anterior portion of the abdomen and anterior chest region and parallel to the third towel. The towels are held in place with towel forceps. The laparotomy sheet is draped over the patient (Chapter 4).

Operations on the Kidney

Nephrectomy

Definition.—Removal of the right or left kidney through one of the following approaches: lumbar, transperitoneal, thoracico-abdominal or dorsal lumbar flap, or retroperitoneal incision.[2,3,12]

Purposes.—To treat renal tumors, injured kidney, a congenital unilateral anomaly with a renal obstruction, severe hydronephrosis, renal tuberculosis of one kidney if the other is free of infection. It is also performed to treat cortical abscesses, calculous pyonephrosis, with or without stones, if the other kidney is functioning.

Contraindications.—When tests indicate that the other kidney's functional capacity is poor, or when the patient has a severe cardiovascular disease, a respiratory infection, or severe nutritional deficiencies, a nephrectomy is seldom performed.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney.

When both kidneys or adrenal glands are to be operated upon, the patient may be placed on the operating table in a prone (face-lying) position (Chapter 9). A lateral chest position (transthoracic approach) may be used when a large tumor is suspected; however, in most cases a lateral position and a thoracoabdominal approach is used (Chapter 11).

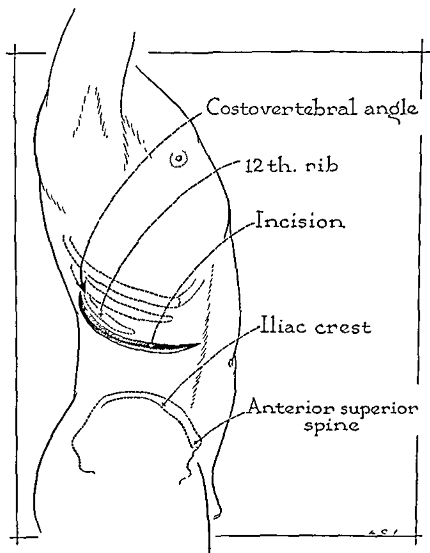


Fig 427—Incision for the lumbar approach to the kidney It is made parallel to the twelfth rib and 1 cm below it, extends from the costovertebral angle to a point 3 cm above the anterosuperior iliac spine (From Barnes, R W, and Hadley, H L. Urological Practice, St Louis, 1954, The C V Mosby Co)

Incisional Approaches for Open Surgery on the Kidney and Ureter

The skin area to be prepared and exposed will depend upon the type of incision to be made. With the patient in a lateral position, an S-shaped, lumbar, or hockey-stick incision may be made (Chapter 11).

The lumbar or S-shaped incision begins in the costovertebral angle and parallel to the twelfth rib (about 1 cm below it) and extends downward and forward between the iliac crest and thorax, ending about 3 cm. above the anterosuperior iliac spine (Fig. 427).



Fig 430.—The kidney is removed, after severing the pedicle between the two forceps or distal to the second forceps when only two are used. The kidney is shown attached only to ureter ligature placed around pedicle behind proximal hemostat. Two additional ligatures are applied as the hemostats are removed. Usually the ureter is divided and the kidney removed from the wound before the pedicle is ligated. (From Dodson, A. I.: Urological Surgery, St Louis, 1956, The C. V. Mosby Co)

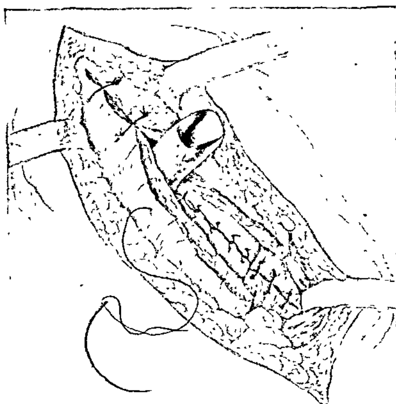


Fig 431.—In closing a lumbar incision, each muscle layer is accurately approximated with chromic gut No 2-0 sutures before the superficial fascia is approximated with chromic gut No. 4-0 sutures; the skin edges are approximated with silk nylon, or stainless steel No. 4-0 or 5-0. (From Dodson, A. I: Urological Surgery, St Louis, 1956, The C V. Mosby Co.)

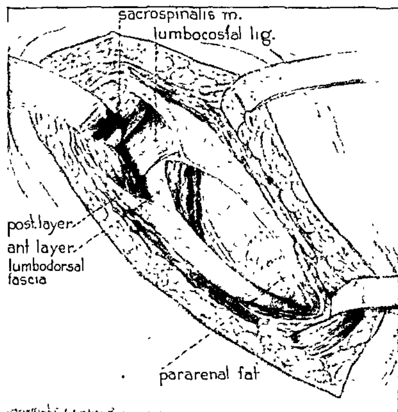


Fig 428—Through a lumbar incision, superficial fascia, and division of the latissimus dorsi muscle, the posterior fibers of the internal oblique muscle and the lumbar fascia have been divided, thereby exposing the fat and fascia which surround the kidney. The lumbocostal ligament is exposed and divided to provide for better exposure of the upper angle of the wound (From Dodson, A. I: Urological Surgery, St Louis, 1956, The C. V. Mosby Co)



Fig 429.—Three curved hemostats grasp the renal pedicle. Dotted line indicates area at which pedicle is divided. (From Dodson, A. I: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co.)

Steps	*Items*
7. The kidney pedicle is isolated and clamped, using two or three clamps, depending upon its length (Fig. 429). Vessels are ligated. The pedicle may be doubly ligated without using hemostats (Fig. 430). The kidney is removed. The wound cavity is examined, gauze pads and soiled instruments are discarded, and bleeding vessels are ligated. The wound may be drained.	7. Kidney pedicle clamps suitable to position and length of pedicle, 3 Herrick, Young, or Ockerblad clamps, ligatures—chromic gut No. 1 or 2, 18 inches, or transfixion sutures swaged to needles, sponges on holders, suction apparatus, Rochester-Pean hemostats, long suture scissors, long thumb forceps, moist gauze packs, Penrose tube with plain gauze packing down through it, or black rubber tube, tissue thumb forceps without teeth
8a. Wound closure for lumbar approach (Fig. 431): The transversalis, internal oblique, external oblique, and the superficial fascia are closed separately to avoid postoperative hernia or injury to the nerves. The table is levelled to relieve wound tension.	8a. Clean towels and gauze pads, Richardson, Parker, or Roux retractors, 2 tissue forceps, 2 and 3 teeth, 2 needle holders, straight and curved scissors, Allis forceps, sponges on holders, Mayo-Pean hemostats, sutures—continuous or interrupted, chromic gut No. 0 or silk No. 2-0 attached to Mayo or swaged-on needles, interrupted chromic gut No. 2-0 or silk No. 3-0 sutures for the superficial fascia
b. Tension sutures may be inserted.	b. Stainless steel, silk, or nylon threaded on surgeon's needle, 3/8-curved cutting-edge No. 4 or swaged-on needles, 2 heavy needle holders, rubber or cotton guards or bumpers
c. The skin edges are approximated with interrupted sutures. A drain is secured to the skin by a suture, and wound dressings are applied.	c. Silk No. 4-0 threaded on Keith needle or autoclips and holders, dressing set

(2) *Opening and Closure of Transperitoneal Approach.*—The kidney is exposed and removed through one of the following incisions: oblique paramedian, rectus, or transverse (Chapter 11). The abdominal cavity is opened and the kidney removed as for lumbar procedure. The wound is closed in layers as described for closure of celiotomy (Fig. 432)

(3) *Opening and Closure of Vertical Incision of Simon.*—The incision is made just mesial to the lateral edge of the erector spinal muscle and extends from the twelfth rib downward to near the crest of the ilium. This approach may be used in tall, thin patients, but not in patients who are very stout or short. Closure as described for celiotomy.

(4) *Opening and Closure of Lumbar Incision With Resection of the Twelfth Rib*—Occasionally this approach is used to treat a solitary renal cyst or to remove a diseased portion of a double kidney or the diseased nonfunctioning

Operative Procedure.—One of several incisional approaches, as described previously, may be used.

(1) *Lumbar Incision.*—With or without rib resection.

Steps	*Items*
1. The incision is carried through the skin, fat, and superficial fascia.	1. Scalpel, 2 tissue forceps with teeth, gauze sponges, Crile or Kelly hemostats, ligatures, surgical gut plain No. 2-0, scissors, basin for discarded instruments
2. The external oblique muscle, the latissimus dorsi muscle, and the internal oblique muscle are exposed Portions of the dorsi, external oblique, posterior inferior serratus, and anterior oblique muscles are divided and retracted. Bleeding is controlled. (Fig. 428.)	2. Israel and Richardson retractors, Mayo-Rochester and Crile hemostats, tissue forceps, 2 and 3 teeth, scalpel, surgical gut, plain or chromic No. 2-0, needle holder, suture scissors, gauze sponges, curved scissors, moist gauze pads
3. The transversalis fascia is incised. Then the iliohypogastric and ilioinguinal nerves are identified and retracted. The sacrospinalis muscle is retracted. The deep lumbar fascia is separated and the quadratus lumborum muscle may be divided. The pleura, peritoneum, and twelfth thoracic artery and nerve are identified and retracted. Bleeding is controlled. Tissue tears are sutured.	3. Scalpel, moist gauze sponges on holders, curved scissors, Deaver retractors, desired size, flexible retractor, long tissue forceps, 1 and 2 teeth, long Mayo curved scissors, hemostats, long Babcock or Allis forceps, ligatures, plain or chromic gut No. 0 or 2-0 or silk No. 3-0, chromic gut No. 2-0 or silk No. 3-0 swaged-on ½-circle taper-point needle, suture scissors, Mayo-Harrington scissors, long narrow-pointed dressing forceps, 8 inches
4 *For resection, the twelfth, eleventh, or tenth ribs:* The periosteum is removed, the lumbocostal ligaments of the ribs are incised, and a segment of each rib is removed.	4. Alexander costal periosteotome, Doyen rib stripper, Ochsner hemostat, Allis forceps, long Mayo scissors, moist pads to protect the pleura, Semb or Stille rib shears, rongeur, Deaver retractors, moist sponges on holders
5. Gerota's fascia is grasped and opened The kidney is exposed and freed from its fatty capsule	5. Long tissue forceps, knife No. 10 on handle 3 L, Kelly retractor, Mayo scissors, Allis forceps, narrow Deaver retractor, Mayo-Harrington scissors, Rochester-Pean hemostats
6. The ureter is identified, separated, and retracted; then, doubly clamped, divided, and ligated	6 Babcock or ureter forceps, long tissue forceps, Mayo-Harrington scissors, Rochester-Pean hemostats, ligatures—chromic gut No. 0 or 1, 18 to 20 inches, Randall kidney forceps, if desired, suction apparatus, pads

Steps	*Items*
7. The kidney pedicle is isolated and clamped, using two or three clamps, depending upon its length (Fig. 429). Vessels are ligated. The pedicle may be doubly ligated without using hemostats (Fig. 430). The kidney is removed. The wound cavity is examined, gauze pads and soiled instruments are discarded, and bleeding vessels are ligated. The wound may be drained.	7. Kidney pedicle clamps suitable to position and length of pedicle, 3 Herrick, Young, or Ockerblad clamps, ligatures—chromic gut No. 1 or 2, 18 inches, or transfixion sutures swaged to needles, sponges on holders, suction apparatus, Rochester-Pean hemostats, long suture scissors, long thumb forceps, moist gauze packs, Penrose tube with plain gauze packing down through it, or black rubber tube, tissue thumb forceps without teeth
8a. Wound closure for lumbar approach (Fig. 431): The transversalis, internal oblique, external oblique, and the superficial fascia are closed separately to avoid postoperative hernia or injury to the nerves. The table is levelled to relieve wound tension.	8a. Clean towels and gauze pads, Richardson, Parker, or Roux retractors, 2 tissue forceps, 2 and 3 teeth, 2 needle holders, straight and curved scissors, Allis forceps, sponges on holders, Mayo-Pean hemostats, sutures—continuous or interrupted, chromic gut No. 0 or silk No. 2-0 attached to Mayo or swaged-on needles, interrupted chromic gut No. 2-0 or silk No. 3-0 sutures for the superficial fascia
b. Tension sutures may be inserted.	b. Stainless steel, silk, or nylon threaded on surgeon's needle, 3/8-curved cutting-edge No. 4 or swaged-on needles, 2 heavy needle holders, rubber or cotton guards or bumpers
c. The skin edges are approximated with interrupted sutures. A drain is secured to the skin by a suture, and wound dressings are applied.	c. Silk No. 4-0 threaded on Keith needle or autoclips and holders, dressing set

(2) *Opening and Closure of Transperitoneal Approach.*—The kidney is exposed and removed through one of the following incisions: oblique paramedian, rectus, or transverse (Chapter 11). The abdominal cavity is opened and the kidney removed as for lumbar procedure The wound is closed in layers as described for closure of celiotomy (Fig. 432)

(3) *Opening and Closure of Vertical Incision of Simon.*—The incision is made just mesial to the lateral edge of the erector spinal muscle and extends from the twelfth rib downward to near the crest of the ilium This approach may be used in tall, thin patients, but not in patients who are very stout or short. Closure as described for celiotomy.

(4) *Opening and Closure of Lumbar Incision With Resection of the Twelfth Rib.*—Occasionally this approach is used to treat a solitary renal cyst or to remove a diseased portion of a double kidney or the diseased nonfunctioning

Operative Procedure.—One of several incisional approaches, as described previously, may be used.

(1) *Lumbar Incision.*—With or without rib resection.

Steps	*Items*
1. The incision is carried through the skin, fat, and superficial fascia.	1. Scalpel, 2 tissue forceps with teeth, gauze sponges, Crile or Kelly hemostats, ligatures, surgical gut plain No. 2-0, scissors, basin for discarded instruments
2. The external oblique muscle, the latissimus dorsi muscle, and the internal oblique muscle are exposed. Portions of the dorsi, external oblique, posterior inferior serratus, and anterior oblique muscles are divided and retracted. Bleeding is controlled. (Fig. 428.)	2. Israel and Richardson retractors, Mayo-Rochester and Crile hemostats, tissue forceps, 2 and 3 teeth, scalpel, surgical gut, plain or chromic No. 2-0, needle holder, suture scissors, gauze sponges, curved scissors, moist gauze pads
3. The transversalis fascia is incised. Then the iliohypogastric and ilioinguinal nerves are identified and retracted. The sacrospinalis muscle is retracted. The deep lumbar fascia is separated and the quadratus lumborum muscle may be divided. The pleura, peritoneum, and twelfth thoracic artery and nerve are identified and retracted. Bleeding is controlled. Tissue tears are sutured.	3. Scalpel, moist gauze sponges on holders, curved scissors, Deaver retractors, desired size, flexible retractor, long tissue forceps, 1 and 2 teeth, long Mayo curved scissors, hemostats, long Babcock or Allis forceps, ligatures, plain or chromic gut No. 0 or 2-0 or silk No 3-0, chromic gut No. 2-0 or silk No. 3-0 swaged-on ½-circle taper-point needle, suture scissors, Mayo-Harrington scissors, long narrow-pointed dressing forceps, 8 inches
4. *For resection, the twelfth, eleventh, or tenth ribs:* The periosteum is removed, the lumbocostal ligaments of the ribs are incised, and a segment of each rib is removed.	4. Alexander costal periosteotome, Doyen rib stripper, Ochsner hemostat, Allis forceps, long Mayo scissors, moist pads to protect the pleura, Semb or Stille rib shears, rongeur, Deaver retractors, moist sponges on holders
5. Gerota's fascia is grasped and opened. The kidney is exposed and freed from its fatty capsule.	5. Long tissue forceps, knife No. 10 on handle 3 L, Kelly retractor, Mayo scissors, Allis forceps, narrow Deaver retractor, Mayo-Harrington scissors, Rochester-Pean hemostats
6. The ureter is identified, separated, and retracted; then, doubly clamped, divided, and ligated.	6. Babcock or ureter forceps, long tissue forceps, Mayo-Harrington scissors, Rochester-Pean hemostats, ligatures—chromic gut No 0 or 1, 18 to 20 inches, Randall kidney forceps, if desired, suction apparatus, pads

The patient may suffer pain due to kinking of the vascular pedicle which results from excessive mobility and rotation of the kidney. In the presence of ptosis of the kidney, interference of renal drainage occurs.

Purposes.—To suspend the kidney and create a situation in which adhesions will form to help hold the kidney in place, to permit adequate renal drainage, and to prevent traction on the vascular pedicle and adjacent organs.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for kidney surgery. Chromic ribbon gut suture should be added for a Lowsley nephropexy.

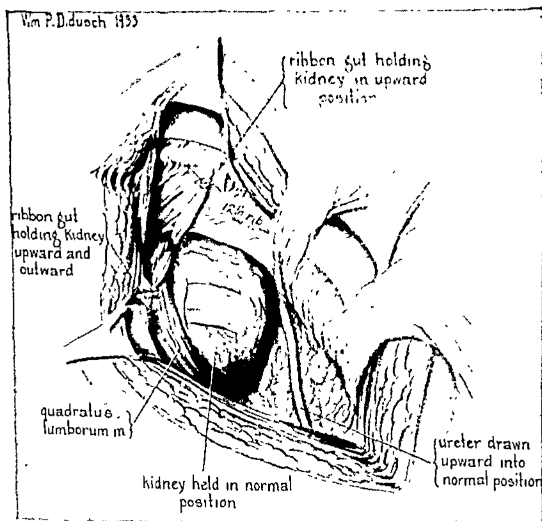


Fig. 433.—Lowsley nephropexy. The capsule is split along the convex surface, and the kidney is surrounded by chromic ribbon gut near the upper and lower poles

Operative Procedure.—

(1) *The Lowsley Nephropexy* (Fig. 433).—Through a lumbar incision the kidney is suspended, using chromic gut swaged-on needles. The true capsule of the kidney is divided and stripped back. The ribbon gut sutures are passed around both poles of the kidney and through straps made in the renal capsule. The sutures are tied separately; then their free ends are tied together to help hold the suture in place. The free ends of the sutures are threaded onto needles

portion of the kidney. The incision is made directly over the twelfth rib and extends from about the external margin of the sacrospinalis muscle to just beyond the tip of the rib. Closure is carried out as described for steps of lumbar incision with rib resection, the vascular pedicle is clamped and ligated, and the kidney pedicle is divided and ligated as for lumbar procedure. The wound is closed as for lumbar nephrectomy.

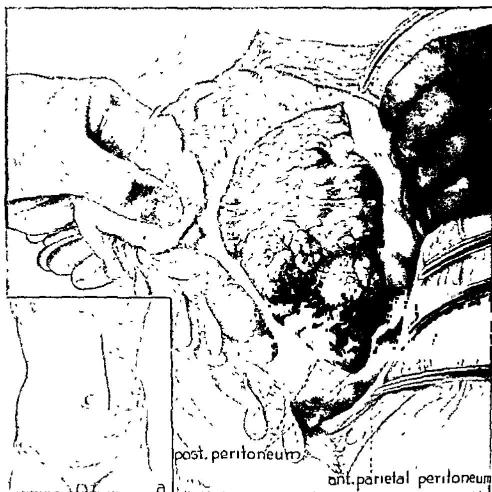


Fig 432.—Transperitoneal nephrectomy (left). Inset. Line of abdominal incision. An incision has been made behind the peritoneum opposite the outer margin of the colon. (From Dodson, A I. Urological Surgery, St. Louis, 1956, The C V. Mosby Co)

Nephropexy

Definition.—Fixation of the kidney.

Considerations.—One of several techniques may be followed. These include Deming, Kelly, Young, and Lowsley nephropexy, the psoas muscle fixation, and subcostal lower pole nephropexy. Nepropexy is indicated when palliative measures have failed to remedy the symptoms resulting from nephroptosis or the so-called dropped or floating kidney. The psoas fixation and Deming or Lowsley nephropexy may be performed to treat nephroptosis; and the subcostal lower pole nephropexy may be indicated to permit direct exposure of the kidney for removal of renal calculi later.[1, 2, 12, 17]

Nephrotomy and Nephrolithotomy

Definition.—The term nephrotomy means making an incision into the kidney; nephrolithotomy consists of incising the kidney and removing one or more stones embedded in the renal substance.

Considerations.—In some cases, following a nephrotomy or nephrolithotomy, a kidney fixation is done by means of a Lowsley, Deming, or other type of nephropexy.

Purposes.—To prevent the substance of the kidney from becoming fibrotic due to the presence of stones, and to relieve aching pain originating in the angle of the vertebral column and the ribs.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, adding special instruments listed under nephrolithotomy and nephropexy setups.

Operative Procedure.—

Steps	*Items*
1-6. As described for nephrectomy.	1-6. As described for nephrectomy
7. The kidney is exposed. The renal pedicle is exposed. Blood flow is controlled by means of pressure on the renal vessels.	7. Long curved scissors, 2 long tissue forceps with teeth, 2 long tissue forceps without teeth, Allis-Adair forceps, Mayo-Pean hemostats, suction set, laparotomy pads, 2 rubber-shod intestinal forceps
8. The convex aspect of the kidney is exposed; an incision is made into the true capsule of the kidney. The incision is carried down to the stone, which is removed with forceps.	8. Laparotomy pads, Allis-Adair forceps, tissue forceps with 2 and 3 teeth, scalpel with long handle and small blade, suction set, Rochester or Randall kidney stone forceps, Mayo common duct scoops, sponges on holders, basin for specimen
9. The kidney wound is closed, using chromic gut sutures tied over pieces of fat, or chromic ribbon gut sutures as described for nephropexy. Frequently, a nephrostomy tube is inserted. The kidney is returned to its normal position.	9. Deaver retractors, chromic gut No. 2-0 or 3-0 or chromic ribbon gut swaged-on ½-circle intestinal needles, large size (Chapter 5), scissors, needle holders, tissue forceps with teeth, laparotomy pads
10 Drainage may be established. The lumbar wound is closed in layers, and dressings are secured over the wound.	10. Pezzer or Robinson catheter, soft rubber tube 8 inches long or cigarette drain, sutures as described for nephrectomy, gauze compresses 4 by 8 inches, or other type of wound dressing

and the sutures placed in the surrounding adjacent muscles to form a sling for the kidney. The wound is closed in layers.[3]

(2) *The Psoas Fixation.*—The renal capsule is incised in its posterior medial aspect, as well as the fascial layer of the psoas major muscle. The edges of the renal capsule are sutured to the incised fascia, thereby fixing the position of the kidney with a wide fascial suture.[5,8,18]

(3) *The Deming Nephropexy.*—The perirenal fascia of Gerota is sutured to the muscle wall posterior to the kidney, thereby forming a fascial sling beneath the lower kidney pole.[6]

(4) *The Subcostal Nephropexy.*—The incised edges of the renal capsule are sutured to the costovertebral ligament.



Fig 434.—Dodson's modification of the Kelly nephropexy After completely freeing the kidney and upper portion of the ureter, two Brodel sutures of No 1 chromic catgut are taken on the convex border of the kidney, including only the capsule The upper suture, which is taken just below the midportion of the kidney, is carried above the twelfth rib as far posteriorly as possible, the lower suture taken at the lower pole is sutured to the quadratus lumborum at an appropriate distance below Elimination of the upper suture permits the kidney to be placed higher than in the original Kelly operation With the use of chromic catgut which includes only the capsule, there is no renal injury or danger of sinus (From Dodson, A I.: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

Nephrotomy and Nephrolithotomy

Definition.—The term nephrotomy means making an incision into the kidney; nephrolithotomy consists of incising the kidney and removing one or more stones embedded in the renal substance.

Considerations.—In some cases, following a nephrotomy or nephrolithotomy, a kidney fixation is done by means of a Lowsley, Deming, or other type of nephropexy.

Purposes.—To prevent the substance of the kidney from becoming fibrotic due to the presence of stones, and to relieve aching pain originating in the angle of the vertebral column and the ribs.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, adding special instruments listed under nephrolithotomy and nephropexy setups.

Operative Procedure.—

Steps	*Items*
1-6. As described for nephrectomy.	1-6. As described for nephrectomy
7. The kidney is exposed. The renal pedicle is exposed. Blood flow is controlled by means of pressure on the renal vessels.	7. Long curved scissors, 2 long tissue forceps with teeth, 2 long tissue forceps without teeth, Allis-Adair forceps, Mayo-Pean hemostats, suction set, laparotomy pads, 2 rubber-shod intestinal forceps
8. The convex aspect of the kidney is exposed; an incision is made into the true capsule of the kidney. The incision is carried down to the stone, which is removed with forceps.	8. Laparotomy pads, Allis-Adair forceps, tissue forceps with 2 and 3 teeth, scalpel with long handle and small blade, suction set, Rochester or Randall kidney stone forceps, Mayo common duct scoops, sponges on holders, basin for specimen
9. The kidney wound is closed, using chromic gut sutures tied over pieces of fat, or chromic ribbon gut sutures as described for nephropexy. Frequently, a nephrostomy tube is inserted. The kidney is returned to its normal position.	9. Deaver retractors, chromic gut No 2-0 or 3-0 or chromic ribbon gut swaged-on ½-circle intestinal needles, large size (Chapter 5), scissors, needle holders, tissue forceps with teeth, laparotomy pads
10 Drainage may be established. The lumbar wound is closed in layers, and dressings are secured over the wound.	10. Pezzer or Robinson catheter, soft rubber tube 8 inches long or cigarette drain, sutures as described for nephrectomy, gauze compresses 4 by 8 inches, or other type of wound dressing

Nephrostomy

Definition.—Drainage of the renal pelvis by means of a catheter which is inserted through the renal parenchyma.

Purposes.—To correct an obstruction of the urinary tract, to conserve and permit physiologic restoration of renal tissue that has been impaired by disease, to provide permanent drainage when a ureter is unable to function, to treat anuria as an emergency measure, or to drain the kidney during the postoperative period following a plastic repair on the kidney and renal pelvis.[2, 10, 18, 19]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney and nephrostomy setup.

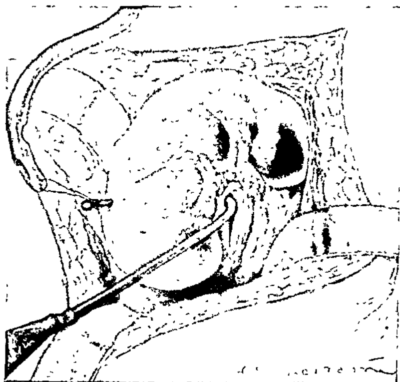


Fig 435 —Dodson's modification of Cabot's nephrostomy. The pelvis is opened and a bent probe is thrust through to the cortex near the lower pole. A suture is taken through the tip of a catheter and tied to the end of the probe As the probe is withdrawn, the tip of the catheter is drawn into the pelvis of the kidney The suture is removed and the catheter is sutured to the renal capsule with chromic gut Then the pyelotomy wound is closed. (From Dodson, A. I: Urological Surgery, St Louis, 1956, The C V Mosby Co)

Operative Procedure.—

(1) *Cabot Method and Modifications.*—As described and shown in Fig. 435.

(2) *Alternate Method*—The kidney is exposed, the kidney pelvis opened, and a Pezzer, Malecot, or Foley catheter inserted into the kidney. The proximal end of the tube is secured in the kidney with a purse-string suture and mattress sutures tied over pieces of fat. Following a plastic operation on the kidney and pelvis, a splinting catheter, such as the Cumming or Kimball type, is also inserted into the kidney and a portion of the ureter. If a Foley catheter is inserted, the bag is slightly distended, using 3 to 5 ml of sterile distilled water in

an Asepto syringe. The distal end of the nephrostomy tube is secured to the skin with a silk or nylon suture.

After the lumbar wound has been closed and dressed, the nephrostomy tube or tubes are connected to the free end of the sterile plastic tubing attached to the bedside drainage bottle.

Pyelotomy and Pyelolithotomy

Definition.—A pyelotomy is an incision into the renal pelvis, and pyelolithotomy is removal of a calculus from the renal pelvis or from one of the calyces.

Considerations.—Under certain conditions, substances present in the urine form into a hard substance called a stone or calculus. A small kidney stone may remain in the kidney and increase in size so that it cannot pass through the ureter (Fig. 420). When a stone is free in the renal pelvis, it may drop down on occasion and occlude the ureteral opening, thereby preventing the urine from passing out of the pelvis of the kidney. In such a situation hydronephrosis may result; and a stone that continues to grow into a calyx of the kidney may destroy the secreting substance of the kidney.[2, 9, 15]

Purpose.—To permit proper functioning of the urinary tract and prevent destruction of the kidney substance.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for kidney surgery and pyelolithotomy setup. In some cases x-ray equipment will be needed to examine the kidney under the fluoroscope or to take pictures of the exposed kidney.

Operative Procedure.—In general, the steps and items include the following:

Steps	*Items*
1-6. As described for lumbar approach in nephrectomy.	1-6. As described for nephrectomy
7. The kidney is mobilized. The upper third of the ureter and posterior aspect of the kidney pelvis are freed from the fascia of Gerota and the perirenal fat, and the renal pedicle is retracted.	7. Moist gauze pads, Deaver, Richardson, or Kelly retractors, Mayo-Harrington scissors, long tissue forceps, long Babcock or Judd-Allis forceps, ureteral dissector or catheter to retract renal pedicle
8. The posterior pelvic artery is ligated or retracted.	8. Small catheter or free ligature chromic gut No. 0, long tissue forceps without teeth, scissors, Rochester-Pean hemostats
9. *Pyelotomy:* A small incision is made in the renal pelvis and traction sutures are inserted to hold it open.	9. Randall forceps with desired curve, common duct scoops, Asepto syringe, saline solution and catheter, suction set, ureteral catheter, ureteral guide if needed
10. *Pyelolithotomy:* Stone forceps or scoops are introduced into the renal pelvis and the stone is removed. The kidney pelvis or calyces are explored. Bleeding is controlled. The ureter may be explored.	10. Randall forceps, desired curve, common duct scoops, Asepto syringe, saline solution, catheter, suction set, ureteral catheter, ureteral guide if needed

Steps	*Items*
11. The renal pelvis incision may be closed with a suture.	11. Chromic gut No. 4-0 swaged-on ½-circle intestinal needle, needle holder, tissue forceps with and without teeth, 7 inches, scissors
12. Drainage is established by insertion of a tube or catheter down to the renal pelvic wound; the distal end of the drainage tube is secured to the incisional wound with a suture.	12. Soft rubber tubing 10 inches long or Robinson catheter, silk or nylon No. 4-0 threaded on ⅜-circle cutting-edge needle or Keith needle, tissue forceps with teeth, scissors
13. The wound is closed in layers and dressings are applied.	13. As described for nephrectomy, bottle and tubing set for collecting drainage, if desired, dressings and cotton pad

Pyelostomy

Definition.—Establishment of drainage through the renal pelvis.

Purposes.—To provide an opening in the pelvis of the kidney for an indefinite period so that the infecting organisms and substances may leave the kidney, and to permit irrigation of the kidney pelvis.[2, 17]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for kidney surgery and for nephrostomy.

Operative Procedure.—Usually through a lumbar incision the renal pelvis is opened, and a large indwelling catheter (Pezzer or Malecot) is inserted. The wound is closed in layers as described for nephrectomy.

Pyeloplasty Operations

Definition.—Through a lumbar incision the renal pelvis is exposed; adhesions, aberrant blood vessels, or obstructive lesions are removed, and appropriate plastic repair of the pelvis and/or ureteropelvic junction are carried out.

Purpose.—To create a better anatomic relationship between the renal pelvis and upper portion of the ureter, thereby relieving pain and permitting urine to pass from the renal pelvis to the ureter.

Considerations.—In patients with hydronephrosis, a pyeloplasty operation may be indicated to treat one or several conditions which cause hydronephrosis. Such conditions may require ligation of aberrant vessels, division of fibrous bands, correction of stenotic lesions of the ureteropelvic junction, or reconstruction of a redundant or poor-functioning renal pelvis.[1,2,5]

Ureteropyelostomy.—The diseased portion of the ureter is removed, and its remaining portion implanted into the pelvis of the kidney.

Ureteroplasty.—The ureter is reconstructed at the ureteropelvic junction.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, adding instruments listed for pyelolithotomy and nephrostomy with ureteral splinting catheters.

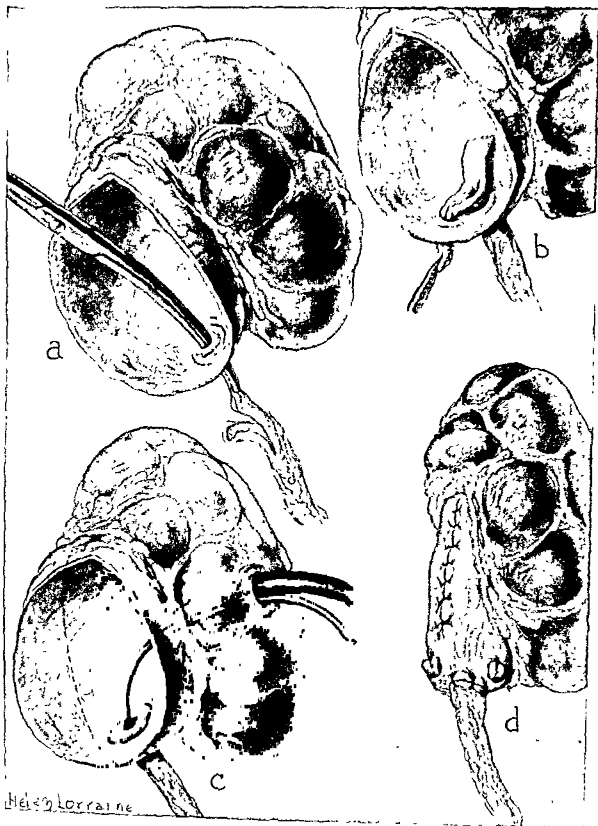


Fig 436—Ureteropyeloneostomy (Lubash method) Hydronephrosis due to obstruction at the ureteropelvic juncture (From *Dodson, A I* Urological Surgery, St Louis, 1956, The C. V. Mosby Co)

Operative Procedure (Foley Y-Plasty Method).—

1. The kidney pelvis and upper ureter are exposed through a lumbar incision as described for nephrectomy.

2. At the strictured site of the ureteropelvic junction a Y-shaped incision is made and closed in a fashion to form a V (Fig. 437). A ureteral splint is introduced. The V wound is closed with chromic gut No. 4-0 swaged-on intestinal needle.

A nephrostomy tube is introduced. A nephropexy may be performed. The lumbar incision is closed in layers as described for nephrectomy. The splinting catheter is usually left in place for fourteen or more days and the other tube until adequate drainage through the pelvic outlet is assured.

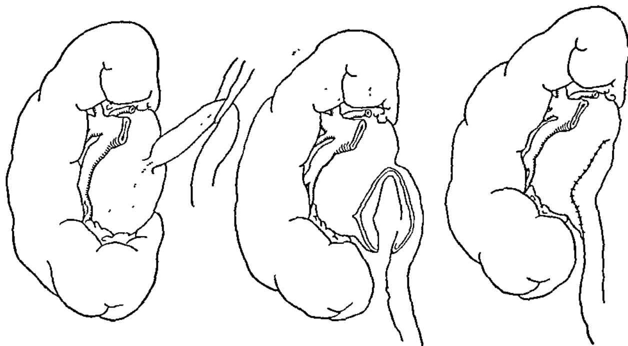


Fig 437.—The Foley pyeloureteroplasty (From Dodson, A. I.: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

Incision and Drainage of Kidney or Perinephritic Abscess

Definition.—Through a lumbar approach the kidney is incised and drained.

Purpose.—To treat a large abscess of the kidney resulting from renal carbuncles caused by the presence of staphylococci, or to treat subcortical, cortical, medullary, or parapelvic abscesses.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, omitting kidney clamps and stone forceps.

Operative Procedure.—The kidney is exposed as for nephrectomy. The abscess is incised and a soft rubber tube or catheter is inserted. The lumbar incision is closed as described for nephrectomy.

Heminephrectomy

Definition.—Removal of a portion of the kidney.

Purpose.—To treat a lesion that does not require the sacrifice of the entire kidney.

Setup, Position, Skin Preparation, and Draping Procedure.—Basic setup for kidney surgery. A transperitoneal or lumbar approach may be used (Fig. 427 or 432).

Operative Procedure.—The kidney is exposed and the renal vessels are compressed by a rubber-shod clamp. The diseased kidney tissue is excised. The bleeding is controlled by mattress sutures, using chromic gut No. 3-0 swaged-on ½-circle intestinal needles, large size. The sutures are placed in the kidney wound and secured over pieces of fat to prevent them from pulling through the kidney substance. A drainage tube is inserted into the wound, which is closed in layers (Fig. 431).

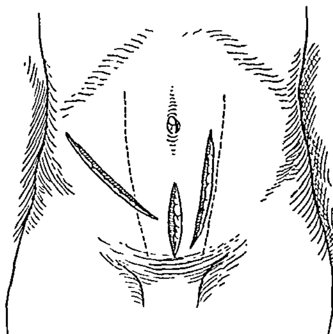


Fig 438.—The types of incision commonly used for gaining access to lower portions of ureter and to bladder (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N J.)

Division of Isthmus of a Horseshoe Kidney

Definition.—Through a transperitoneal or retroperitoneal incision (Chapter 11) the isthmus is divided (Fig. 438).

Purposes.—To remove the diseased lesion, and to relieve gastrointestinal disturbances which frequently occur.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for kidney surgery. Long-bladed pedicle clamps and drainage tubes are needed.

Operative Procedure.—The kidney is dissected free, sutures are placed in the kidney fat, and the isthmus is divided. The kidney is secured in place by performing a nephropexy as mentioned and illustrated previously in this chapter.

Division of Aberrant Renal Vessels

Definition.—Through a lumbar incision the aberrant renal vessels are divided.

Purpose.—To relieve an obstruction of urinary flow due to the development of fibrotic vessels which create hydronephrosis.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney. A lumbar or S-shaped incisional approach is made. In some cases this operation is performed with some other operation such as a pyelolithotomy or a pyeloplasty.

Operative Procedure.—Through a lumbar incision the fibrous bands are dissected free, cut, and ligated. In some cases, a stone may be removed, or a plastic operation on the renal pelvis may be performed.

Denervation and Decapsulation of the Kidney

Definition.—Through a S-shaped lumbar incision the renal nerves are excised (Fig. 418).

Purpose.—To relieve renal pain when there is no evidence of kidney disease, and in some cases to treat hypertension when a sympathectomy is indicated, or to relieve urinary suppression.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for kidney surgery, omitting clamps for removal of the kidney. Nerve hooks, as described for sympathectomy (Chap. 6), are added to the kidney setup.

Operative Procedure.—Through a lumbar incision the kidney is exposed, the renal vein and renal artery are exposed, and the nerves freed. In some cases, the capsule of the kidney is removed to relieve renal pain or urinary suppression. The wound is closed as described for nephectomy.

Operations on the Ureter

Standard Setups.—The items needed for operations on the ureter have been listed. The procedures to be carried out for positioning the patient, for disinfecting the operative skin area, and draping the patient have been described previously in this chapter. The position of the patient on the operating room table will depend upon the surgical approach selected

Types of Incisions.—The site of the incision and its length will depend upon the location of the lesion in the ureter and the type of operation to be performed.[2, 8, 12, 16, 20]

For operations on the upper portion of the ureter, the patient is placed on the operating table in a lateral position, and a lumbar incision is usually made.

For operations on the middle portion of the ureter the patient is placed on the operating table in a semilateral or a modified supine position (Chapter 4). The table is tilted toward the left or right to permit the tissues surrounding the affected ureter to fall away from the operative site. A lateral lumbar incision is made.

For operations on the lower portion of the ureter the patient is placed on the operating table in a modified Trendelenburg position (Chapter 15). An extraperitoneal McBurney or muscle-splitting incision is used (Chapter 11).

For operations on the lower portion of the ureter near the bladder, the patient is placed in a modified Trendelenburg position. A midline suprapubic

incision is made. In most cases the bladder is not opened but filled with sterile water, which is withdrawn during the operation.

Ureterolithotomy

Definition.—Through an extraperitoneal incision the affected portion of the ureter is incised and the stone removed.

Purpose.—To relieve an obstruction of the urinary tract.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney and setup listed for ureterolithotomy. The position of the patient and skin area to be prepared will depend upon the surgical approach to be made.

Operative Procedure.—

1. Through an extraperitoneal incision the ureter is identified, the stone palpated, and the ureter freed from its bed and elevated, using a Penrose tube or umbilical cotton tape.
2. The ureter overlying the stone is incised and the stone removed.
3. The ureteral opening is closed with chromic gut No. 4-0 or 3-0 swaged-on small ½-circle intestinal needle.
4. A soft rubber tube, catheter, or cigarette drain is inserted so that its distal end lies at the site of the ureterotomy. The wound is closed in layers and dressing are applied.

Ureterotomy and Ureterostomy

Definition.—A ureterotomy is an incision into the ureter; a ureterostomy is the establishment of ureteral drainage following a ureterotomy.

Purpose.—Ureterotomy is done to remove an obstructive or toxic substance or to remove a foreign body that cannot be removed by means of an endoscope. Ureterostomy is done to drain an infected kidney.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney and ureter, using ureterolithotomy setup. In some cases x-ray equipment will be needed to take x-ray pictures during the operation.

Operative Procedure (Lumbar Approach).—

Steps	*Items*
For ureterotomy:	
1. Through an appropriate incision the ureter is exposed without opening the peritoneal or pleural cavity.	1. Lumbar approach as described for nephrectomy Steps 1 to 6; abdominal incision as described for opening a celiotomy (Chapter 11)
2. The ureter is identified and mobilized, and then grasped above and below the location of the stone to prevent it from moving.	2. Cotton tape or Penrose tubing for traction, narrow blade retractors, small moist laparotomy pads, long curved Metzenbaum or Harrington scissors, tissue forceps, long Babcock forceps, ligatures, Ratcliff forceps

Steps	*Items*
3. The ureter is incised over the stone and the stone removed. The ureter is irrigated and explored. The wound is closed if ureterostomy is not to be performed.	3. Scalpel with long handle and small blade, suction set, laparotomy pads, sponges on holders, traction sutures if desired, Blake stone forceps, Randall forceps, ureteral catheter, Asepto syringe, saline solution
For ureterostomy:	
4. A urethral catheter is introduced into the ureteral opening for temporary drainage; a Foley catheter may be inserted through the ureter into the renal pelvis when permanent drainage is necessary.	4. Nylon, plastic, or rubber catheter No. 10, 12, or 14 F, or Foley catheter No. 14 or 16 F with 5 ml. bag, Asepto syringe, saline solution
5. The ureteral wound is approximated around the catheter, using several interrupted sutures. A drain may be placed in the extraperitoneal cavity near the ureteral wound.	5. Chromic gut No. 3-0 or 4-0 swaged-on ½-circle intestinal needle, needle holders, fine-pointed tissue forceps, Crile and Mayo-Pean hemostats, scissors, Penrose or cigarette drain
6. The wound cavity is closed in layers and dressings are applied.	6. Sutures for closure of lumbar or abdominal wall incision

Cutaneous Ureterostomy

Definition.—Through a paramedian or transverse suprapubic incision the ureter is divided, its distal end ligated, and its proximal end attached to the skin overlying the abdomen.

Purposes.—To divert urinary flow when the bladder is to be removed due to a malignant lesion, and to relieve pain, especially if patient's life expectancy is too uncertain to perform a more extensive method of urinary diversion.[13, 15, 21-23]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, using an ureteroanastomosis setup.

Operative Procedure.—

1. The incision is carried through the skin fat and superficial fascia and muscles just below and about an inch medial to the anterosuperior iliac spine (Fig. 439). Instruments include those used in a suprapubic cystostomy.

2. The fascial attachments of the rectus muscle are separated and retracted. The bleeding vessels are ligated, and the wound edges protected with surgical towels and moist laparotomy pads.

3. The ureter is exposed and mobilized as described for ureterotomy. The lower third of the ureter is divided, its distal end is ligated, and its proximal end is brought through a stab wound that is made above the original opening. Instruments include those used in performing a ureterotomy.

The muscular and fascial layers of the abdominal wound are closed with interrupted chromic gut sutures No. 0 swaged-on ½-circle taper-point needles.

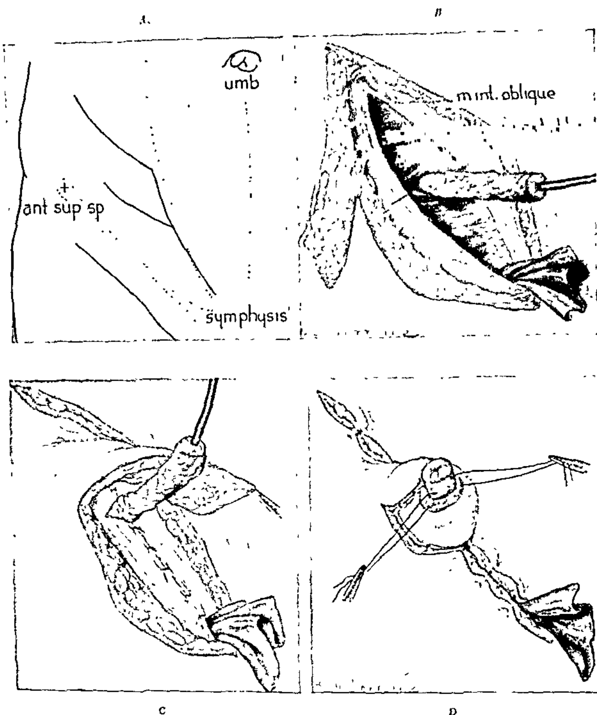


Fig. 439—Transplantation of the ureter to the skin (Dodson method) *A*, Incision and outline of skin flap to be used to cover the protruding portion of the ureter *B*, Ureter protruding through deep abdominal muscles and dissected skin flap. *C*, Method of surrounding ureteral stump with skin flap. *D*, Operation completed except few superficial sutures. (From Dodson, A I · Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

5. A urethral plastic catheter No. 10 or 12 F is inserted through the open ureteral "bud" and passed into the kidney pelvis. The catheter is usually held in place with a suture. The skin is closed around the catheter, and antibiotic solution and dressings are applied to the wounds. The catheter is attached to a bedside urinal, or a cup that can be strapped to the patient's leg.

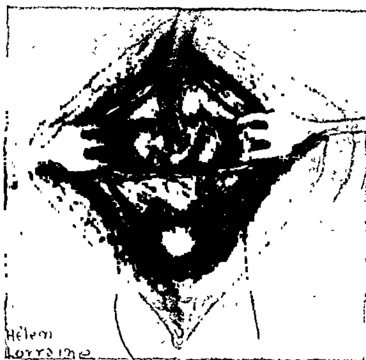


Fig 440—A stab wound has been made within the confines of the purse-string suture, a drainage tube inserted, and suture drawn taut and tied. Then the ends may be secured to the abdominal wall to secure the bladder to the abdominal wall (From Dodson, A. I: Urological Surgery, St. Louis, 1956, The C V Mosby Co)

Ureterointestinal Anastomosis

Definition.—Through a left or right rectus or paramedian incision the ureter is divided and reimplanted into the intestine; the bladder may or may not be removed.

Ureterosigmoidostomy anastomosis consists of dividing the ureter, ligating the lower end (distal), and uniting the upper end (proximal) to the sigmoid colon, with or without a ureteral catheter.

Ureteroileal anastomosis means that the proximal end of the divided ureter is united to the isolated ileal loop.

Considerations.—A ureterointestinal anastomosis and reimplantation of the severed ureter is indicated in the presence of certain types of carcinoma of the bladder, exstrophy of the bladder, and in some cases in the presence of cystitis. Several days before the time of surgery, the patient is given antibiotics and treatments to decrease the bacterial count in the colon.[11, 24, 25]

Purpose.—To divert the urinary flow into the lower portion of the intestinal tract, thus by-passing the diseased bladder and permitting its removal.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney and ureter, using the ureterosigmoidostomy setup. The patient is placed on the table in a modified Trendelenburg position.

Operative Procedure (Ureterosigmoidostomy).—

Steps	*Items*
1. The abdominal cavity is opened, usually through a left rectus incision extending from the symphysis pubis to the umbilicus and through the peritoneum.	1. As described for opening a celiotomy (Chapter 11)
2. Through an incision into the retroperitoneum the right ureter is freed and severed near the bladder. The rectum and rectal sigmoid are exposed and protected. The posterior peritoneum is approximated with sutures. The left ureter is exposed and severed in a similar manner. It is usually brought beneath the sigmoid.	2. Self-retaining retractor, Deaver retractors, moist laparotomy pads, long Babcock forceps, long tissue forceps, scalpel, Harrington scissors, suction set, chromic gut No. 2-0 swaged-on intestinal needle, long needle holder, long fine-pointed tissue forceps, sponges on holders, Rochester-Carmalt or Ockerblad forceps
3. In some cases a ureteral catheter may be inserted into the severed ureters via the urethra.	3. Ureteral catheters, syringe and solution
4. A loop of the sigmoid colon is mobilized, and an incision is made through the serosal and submucosal layers into the lumen of the bowel. A trough is formed for the ureter. The ureteral catheter, if present, is removed. If both ureters are transplanted, the left ureter is anastomosed to the rectosigmoid above the right ureteral anastomosis	4. Babcock forceps, Kelly hemostats, scalpel, scissors, moist laparotomy pads, suction set, aseptic techniques for bowel surgery (Chapter 12)
5. The proximal end of the ureter is split and sutures placed through all its layers; then the ureter is anastomosed to the opening in the bowel, using the attached sutures	5. Chromic gut sutures No. 2-0 or 3-0 swaged-on intestinal needles, needle holders, Metzenbaum scissors, Crile hemostats
6. To complete the anastomosis the sigmoid colon is sutured over the ureter and also secured to the pelvic peritoneum with interrupted sutures.	6. Chromic gut sutures No. 3-0 swaged-on needles, needle holders
7. A cystectomy may or may not be done at this time.	7. As described for cystectomy
8. The abdominal incision is closed in layers and dressings are applied. A colonic irrigator No. 36 F or a rectal catheter No. 30 F may be introduced into the rectum.	8. As described for closure of celiotomy (Chapter 11)

Ureteral Reimplantation (Ureterocystostomy)

Definition.—Through a transperitoneal or retroperitoneal approach the ureter is divided at its point of entrance into the bladder and reimplanted elsewhere in the bladder, followed by cystostomy.

Considerations.—A ureteral reimplantation may be done in the presence of an injury, or lower ureteral stricture, or following removal of a tumor associated with the ureteral orifice.[2]

Purpose.—To provide for proper urinary drainage and, in some cases, to prevent urinary seepage into the vagina.

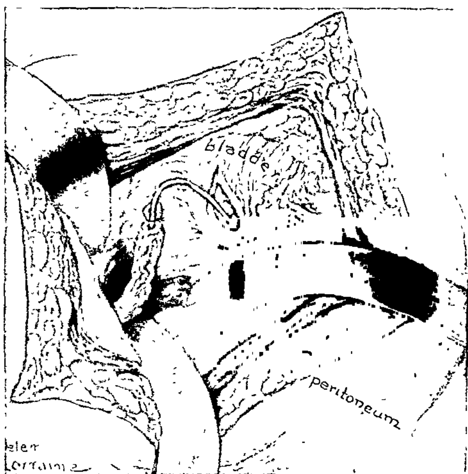


Fig 441 —A small catheter is inserted a few inches into the ureter and secured by a ligature to the beveled end of the ureter to serve as a splint. The ureter enters the bladder beneath a mucosal flap and is held in place with fixation sutures; then the wall of the bladder is closed over the lower end of the ureter. (From Dodson, A I J Urol 55:225, 1946.)

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, using suprapubic cystostomy and special instruments listed under ureterostomy setup A Trendelenburg position is used (Chapter 15).

Operative Procedure.—

1. Through a suprapubic incision the ureter is exposed and freed from its surrounding structures. In the female, the vaginal wall is dissected free, and the ovarian vessels may be ligated and divided.

2. When a partial cystectomy is to be done, the diseased lesion is removed before the ureter is reimplanted.

3. The ureter is divided; an opening is made into the bladder wall, and a flap may be formed. The ureter is anastomosed to the bladder opening with a purse-string and interrupted chromic gut sutures (Fig. 441).

4. A plastic or rubber Robinson 3- or 4-eyed No. 12 or 14 F catheter is inserted into the ureter and brought through the bladder.

5. The bladder is drained with a Pezzer, Malecot, or Foley catheter. The wound is closed as described for suprapubic cystostomy.

Ureteroureteral Anastomosis

Definition.—Union of the cut segments of the ureter by means of sutures and a splinting catheter.

Considerations.—In some patients the cut ureter, resulting from injury or accidental trauma, may be repaired.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for ureterostomy and cystoscopy setup.

Operative Procedure.—Through an extra- or transperitoneal incision the ureteral segments are grasped, approximated, and sutured together over a splinting catheter which is inserted into the ureter through the bladder by means of cystoscopic instruments.

OPEN SURGERY ON THE ADRENAL GLANDS

Definition.—Removal of the whole or part of the adrenal.

Purposes.—To treat hyperfunction of the adrenal, remove adrenal tumors, to treat cortical hyperplasia, or to assist in controlling lesions in other glands, such as carcinoma of the prostate and breast.[2,20-29]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney, using adrenalectomy setup. The patient may be placed on the operating table in a lateral position. In some cases if a bilateral adrenalectomy is to be performed, a prone position may be used (Fig. 426).

When the patient is placed on the operating table in a prone position, the trunk is flexed slightly and the thighs lowered at a 10 degree angle (Chapters 4 and 9). Safety measures must be taken to permit adequate circulatory and respiratory functioning and to eliminate pressure on the nerves and muscles.

Types of Incisions.—A dorsolumbar flap or transabdominal incision may be made. Frequently, the latter is preferred in those patients in whom both adrenals are to be exposed and additional abdominal or retroperitoneal exploration is to be performed. When a bilateral operation is to be performed, the posterior approach (Young) may be used (Fig. 442). The incision is made directly over the eleventh and twelfth ribs, extending along the curve of the twelfth rib, downward and laterally.

Operative Procedure (Young's Bilateral Adrenalectomy).—

1. The skin, fat, superficial fascia, latissimus dorsi muscle, and serratus muscles are divided, exposing the costoverterbral ligaments of the twelfth rib. The rib is exposed and resected subperiosteally.

2. An opening is made through the conjoined portion of the lumbodorsal fascia and the underlying tissue is freed from the costovertebral ligament. Gerota's fascia is incised.

3. The adrenal gland is exposed, and the ateries arising from the aorta are doubly clamped, ligated, and divided. The large veins are clamped, ligated, and divided where they emerge from the hilus of the gland and empty into the inferior vena cava on the right side and into the renal vein on the left.

4. The gland is removed, and the wound is drained and closed in layers as for nephrectomy.

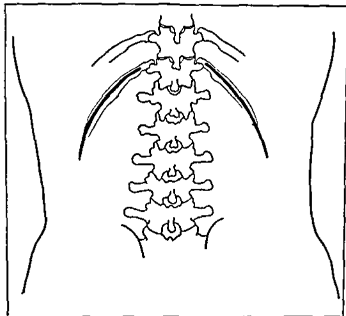


Fig 442—Incisions for simultaneous exposure of both adrenals. (From Dodson, A. I.: Urological Surgery, St Louis, 1956, The C V. Mosby Co)

OPEN SURGERY ON THE BLADDER AND URETHRA

The anatomy and physiology of the bladder, urethra, and reproductive organs in relation to surgical procedures have been described previously in this chapter (Figs. 419 to 422).

The standard setups, positioning of the patient, skin preparation, and draping procedures should serve as guides in caring for patients with various conditions (Chapters 2, 3, and 4).

Setup for Open Surgery on the Bladder

A basic setup should be suitable for various types of operations.

General instruments may include the following.

- 2 Volkman or Murphy retractors, 4-pronged, blunt points, optional
- 2 Parker or Roux retractors
- 2 Greene retractors, optional
- 2 Richardson retractors, medium or small
- 1 Flexible blade retractor
- 2 Kocher retractors, slightly curved
- 1 Masson-Judd or Gossett self-retaining retractor (Fig. 443)
- 8 Sponge-holding forceps, 9½ inches
- 10 Towel forceps, 5½ inches

3 Scalpel handles—2 No. 4 handles; 1 No. 3 handle
4 Tissue forceps with 2 and 3 teeth—2, 5½ inches; 1, 6¾ inches; 1, 7½ inches
3 Tissue forceps—2, 5½ inches; 1, 7½ inches
3 Needle holders—1 medium type and 2 heavy type
1 Set autoclips, 16 or 18 mm., and autoclip holder, optional
14 Rochester-Pean hemostats, curved, 6¼ inches
2 Carmalt-Rochester clamps, curved, 8 inches
8 Crile or Rankin hemostats, straight, 6¼ inches
3 Ochsner clamps, 1 and 2 teeth, straight, 6¼ inches, if desired
4 Allis forceps, 5 and 6 teeth, straight, 6 inches
1 Pool or Millin suction tube, and 2 pieces rubber tubing
1 Ochsner trocar, 6 inches, 21 F for catheter 20 F
3 Urethral sounds, Nos. 16, 18, and 20 F
1 Asepto syringe, 2 ounces

Controlling Hemorrhage

1 High-frequency electrosurgical unit, cords, handles, electrodes
1 Yard plain gauze packing, 2 inches wide
1 Strip hemostatic substance, such as Oxycel, Gelfoam, or Hemopac
1 Angulated drain with irrigation tube and retention disk, desired size, or
1 Marion Pezzer, or Freyer drain (Fig. 444)

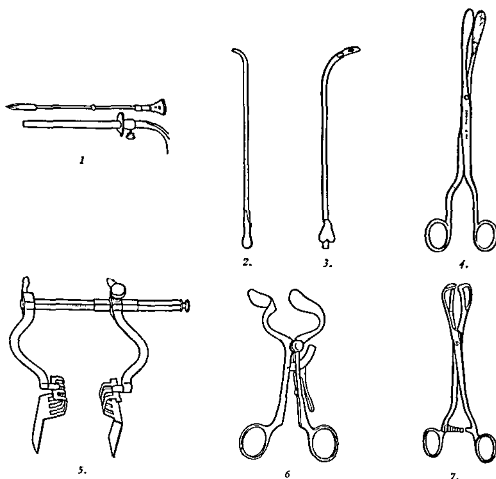


Fig 443—Instruments for open and closed surgery for bladder and urethral procedures: *1*, Lower suprapubic trocar; *2*, Campbell miniature urethral sound for infants, *3*, Le Fort male catheter, *4*, Lewkowitz lithotomy forceps, *5*, Judd-Masson bladder retractor; *6*, Campbell self-retaining bladder retractor, *7*, Young prostatic lobe forceps The instruments as shown are one third actual size (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

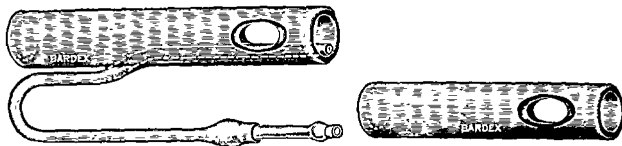


Fig. 444.—*A*, Marion drain, Nos 16 to 28 mm, even sizes *B*, Freyer drain, Nos. 16 to 28 mm., even sizes.

Air vent
Reservoir for fluid
Adjustable clamp
Murphy drip
Air vent tube to break siphon
Elevated portion of drainage tube adjustable to different heights
Catheter to bladder
Drainage bottle on floor

Fig. 445.—Apparatus for tidal irrigation of the bladder (From Barnes, R. W., and Hadley, H. L.: Urological Practice, St Louis, 1954, The C V Mosby Co)

1 Foley catheter No. 20 or 24 F with a 5, 30, 60, or 150 ml. bag (Fig. 449*B*)
Penrose tube, ⅝ inch wide, 12 inches long

Removing Stones or Tumors

1 Electrosurgical unit, including ball and loop electrodes
2 Millin T-shaped stone forceps
2 Millin capsule forceps
1 Lewkowitz lithotomy or Young forceps (Fig. 443)
2 Deaver, Hunt, or Kocher retractors

Establishing Drainage (one of the following)

Freyer tube, straight with elbow
Pezzer, regular or open head, No. 28 F or other
Foley catheter No. 16, 18, or 24 F with 5 ml. bag (Fig. 449*B*)
Malecot catheter, 2- or 4-eyed, No. 24, 30, or 32 F
Colonic irrigation tube No. 36 F, 20 inches
Whistle-tip, angulated catheter No. 20F
Marion drain, short, with right-angle glass connector (Fig. 444)
Screw clamp
Stylet

Sutures

Plain gut No 2-0, optional
Chromic gut Nos. 2-0, 0, and 1
Nylon No. 3-0, stainless steel wire No. 3-0, or gauge 30 threaded or swaged to ⅜-circle cutting-edge needles
Dakin tubing, ½ inch long, for tension guards
2 Mayo ½-circle taper-point needles No. 3
2 Ferguson ½-circle taper-point round-eye No. 8

Textiles

1 Laparotomy pack
1 Basin set
1 Major operating pack
1 Gown set
1 Glove set

Setup for Immediate Preoperative Care of the Bladder

Mayo standard
Lubricant
Towel
Small basin
Gloves
Rochester-Pean hemostat
Antiseptic agent, such as acriflavine 1:5,000
Graduated flask, 500 ml.
Blunt-tipped urethral syringe
Hoffman clamp, if desired
Foley catheter No. 16, 20, or 24 F with 5 ml. bag, or other desired type of catheter
Olive-tip coudé—No. 14 F or whistle-tip catheter No. 18 or 20 F (Fig. 424)
Asepto syringe, 2 ounces

Setups for Different Types of Operations on the Bladder and Urethra

Suprapubic Cystotomy.—Basic bladder and preparation setups.

Suprapubic Cystostomy.—Basic bladder and preparation setups.

Suprapubic Drainage by Puncture Method.—Basic bladder setup for preparation of the patient, plus the following instruments:

1 Aspirating needle, 14 gauge, 4½ inches
1 30 ml. syringe
1 Basin set
1 Scalpel handle; handle No. 3, blade No. 10
1 Mayo scissors, curved, 5½ inches
1 Tissue forceps without teeth, 5½ inches
2 Crile hemostats, straight, 5½ inches
2 Rochester-Pean hemostats, curved, 6¼ inches
1 Walther aspirating trocar and stylet for Robinson and whistle-tip catheter No. 28 F, or Foley catheter, No. 22 F, or Ochsner trocar No 10, 14, 16, 20, 22, or 24 F for

use with Robinson or whistle-tip catheters, sizes 8, 10, 12, 16, 18, or 20 F, respectively
2 Cuticular needles, fused to nylon or silk No 3-0
3 Sponge-holding forceps, 7 inches
4 Towel forceps, 3 inches
1 Needle holder
6 Towels
2 Small sheets or laparotomy sheet
12 Compresses, 4 by 4 inches
1 Absorbent dressing
Sterile saline solution
1 Local set and Novocain solution, if desired
1 Asepto syringe or suction set

Total or Partial Cystectomy.—Basic bladder and preparation steups, adding the following:

3 Deaver retractors, medium and wide widths, with muslin covers
1 Aneurysm or boomerang holder
4 Rochester-Pean hemostats, curved, 7¼ inches
1 Mayo-Harrington scissors
1 Doyen intestinal forceps, with rubber guards
6 Babcock forceps
1 Ureteral forceps
For women, add vaginal preparation tray and posterior colpotomy setup (Chapter 15)
For men, add prostatectomy setup
Ureteroanastomosis setup, if desired

Intravesical Diverticulectomy.—Basic bladder and preparation setups, plus cystectomy instruments.

Meatotomy (Urethra).—Minor perineal setup (Chapter 15) and fine dissecting scissors, tissue forceps, and hemostatic forceps.

Excision of Urethral Caruncle.—Meatotomy setup.

Segmental Resection of Bladder Wall.—Total cystectomy setup.

Urethrotomy (Internal Method).—Complete cystoscopy setup, plus urethrotome filiforms and followers, and electrosurgical unit.

Vesicocutaneous Fistula.—Basic bladder setup.

Vesicointestinal Fistula.—Ureterosigmoidostomy setup.

Vesicovaginal Fistula.—(1) For perineal approach—setup for repair of cystocele; (2) for abdominal approach—setup for cystectomy.

Circumcision.—Small-sized instruments should include the following:

4 Towel forceps
1 Scalpel, handle No. 3 with blade No. 10
1 Tissue forceps without teeth
2 Tissue forceps with teeth
1 Mayo scissors, curved on flat
1 Suture scissors
1 Metzenbaum scissors
6 Kelly hemostats
6 Mosquito (Halsted) hemostats for infant
6 Crile hemostats
6 Kelly hemostats for adult
4 Allis forceps
2 Sponge-holding forceps
1 Needle holder
1 Probe
1 Phimosis clamp, if desired
1 Local injection set and solution, if desired
1 Surgeon's ⅜-circle cutting-edge needle No. 14
Plain or chromic gut No. 2-0 swaged-on needle
Petrolatum gauze, narrow width
Minor pack (towels and sheets)
Circumcision sheet
Gauze compresses (small sizes)
Germicide
Normal saline solution

Simple Amputation of the Penis.—Perineal setup (Chapter 15), plus the following:

Electrosurgical unit	Petrolatum gauze
Indwelling catheter	Penrose drain

Radical Amputation of the Penis.—Simple amputation setup, adding hernial repair setup (Chapter 11).

Repair of Hypospadias and Epispadias.—Hernal repair setup (Chapter 11), adding proper-sized instruments for use in children or infants.

Positioning the Patient, Skin Preparation, and Draping Procedure for Open Surgery on the Bladder, Urethra, or Penis

The patient is placed on the operating table in a supine position, with one arm usually extended on an armrest (Chapter 4). In some cases a modified Trendelenburg position is used (Chapter 15).

The bladder may be distended. In some cases a catheter is passed, using aseptic technique, into the bladder. It is emptied and then distended with an antiseptic solution.

The entire region of the external genitals is cleansed and shaved, and the lower abdominal region and genitals are painted with a germicide (Chapter 3). The prepared skin area is surrounded by surgical towels and the patient draped with a fenestrated sheet (Chapter 4).

Usually a midline incision is made, extending from the pubes to within about 3 cm. of the umbilicus (Fig. 438).[2,12]

For operations on the urethra or penis, the patient is placed on the table in a lithotomy position and draped with a perineal fenestrated sheet (Chapter 15).

Operations

Suprapubic Cystotomy and Cystostomy

Definition.—Through a vertical or transverse suprapubic incision the bladder is opened, drained, and closed.

Purpose.—To remove a stone or foreign body, to excise a tumor, to control hemorrhage, to close a wound of the bladder wall, or to establish temporary or permanent drainage due to a urethral or prostatic obstruction.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the bladder.

Operative Procedure.—The type of incision commonly used to approach the bladder is shown in Figs. 266 and 271, Chapter 11.

Steps	*Items*
1. The abdominal incision is carried through the skin, the subcutaneous tissue, and the fascial layers to expose the sheaths of the right or left rectus abdominis muscle.	1. 2 scalpels, tissue forceps, sponges, Crile hemostats, chromic gut ligatures No. 2-0, straight and curved scissors, basin for skin instruments, packs for wound edges,

Steps	*Items*
The wound edges are protected. The bleeding vessels are ligated. The wound is retracted. When a transverse incision is used, the attachments that join the rectus muscle to the symphysis are cut across so that the muscles can be retracted. (Fig. 271.)	Mayo-Pean hemostats, Parker or Roux retractors
2 The recti muscles are incised or split and retracted; the underlying transversalis fascia is incised and retracted.	2. Scalpel, scissors, abdominal retractors, tissue forceps, sponges on holders, Mayo-Pean hemostats, chromic gut ligatures
3. The prevesical fat and peritoneum are pushed upward and retracted.	3. Small laparotomy pad, self-retaining Deaver retractor, sponges on holders, curved scissors, tissue forceps
4. The fascia over the anterior wall of the bladder is incised.	4. Tissue forceps, sponges on holders, scalpel, curved scissors
5a. The wall of the bladder is grasped on each side of the midline.	5. Allis forceps, chromic gut No. 0 or 1 threaded on Mayo needle No. 4, 2 Crile hemostats for holding sutures
b. Sometimes two Guy sutures are passed through the bladder wall and held, or a purse-string suture is placed in the anterior bladder wall.	
6. A stab wound is made in the bladder. The bleeding vessels are clamped and ligated. Fluid is removed by suction. The size of the opening is enlarged by blunt dissection.	6. Scalpel, scissors, suction set turned on, moist packs, self-retaining bladder retractor, sponges on holders
7. If the urethra is obstructed, a trocar is introduced through the incision and the bladder emptied. Stones are removed, and tumors excised or fulgurated. Bleeding vessels are ligated.	7. Trocar and cannula suction set, Mayo-Pean hemostats, stone forceps, desired type, or electrosurgical unit, ligatures—chromic gut No. 0, and narrow retractors
8. The bladder may be irrigated	8. Urethral catheter, Asepto syringe, basin, and drain, desired type and size
9a. A purse-string suture may be placed in the bladder, encircling the catheter or drain.	9a. Chromic gut sutures No. 0 or 1 threaded or swaged to Mayo type needle No. 3 or 4, tissue forceps
b. A suture is passed through one edge of the bladder muscle and then through the drain and the opposite edge of the bladder muscle.	b As for Step 9a; catheter placed in wound; stylet, if required

Steps	*Items*
10. The prevesical space may be drained. The bladder wall is closed, and the muscle layers are sutured around the drain, if present. The fascia is closed.	10. Penrose or cigarette drain, clean towels, interrupted chromic gut sutures Nos. 0 and 2-0 threaded on Mayo needles, 2 needle holders, tissue forceps, sponges on holders, abdominal retractors
11. Tension sutures may be inserted; the subcutaneous tissue and skin layers are closed. Dressings are applied to the wound and around the drains.	11. Nylon suture threaded on cutting-edge ⅜-curved needles, 2 needle holders, rubber guards, skin clips, or fine nylon or wire for skin closure

Trocar Cystostomy

Definition.—Insertion of a catheter into the bladder by means of a trocar and cannula.

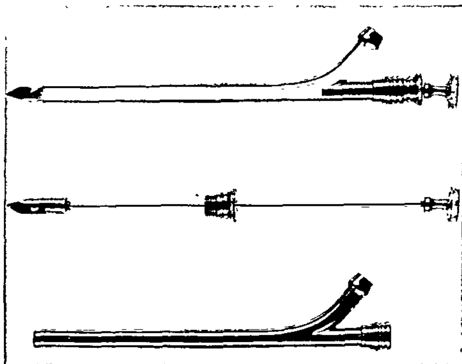
Considerations.—Suprapubic drainage of the bladder by puncture technique may be done when the patient is a poor surgical risk, or when drainage of the bladder is the only objective. This operation is not performed unless the bladder is fully distended.[2, 17]

Purposes.—To relieve retention of urine, thereby reducing the danger of infection and renal damage due to back pressure, and to eliminate the need to perform frequent catheterizations which would promote infection and produce trauma.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup listed for closed drainage and routine skin preparation, as described for open surgery on the bladder.

Operative Procedure.—

1. The bladder is distended and aspirated.	1. Lubricant, urethral catheter, needle, syringe, basin
2. A small incision is made in the skin.	2. Knife, compresses
3. A trocar is inserted through the skin, muscle, and prevesical tissues into the bladder (Fig. 446).	3. Trocar and cannula, suction set
4. When urine begins to flow through the cannula, a catheter, threaded on a stylet, is inserted into the cannula.	4 Catheter, desired type and size, suction set, gauze compresses
5 The cannula is withdrawn and the catheter is sutured to the wound edges.	5. Fine wire, silk, or nylon sutures threaded on skin needles, needle holder, scissors
6. Dressings are applied to the wound.	6. Gauze compresses, adhesive tape



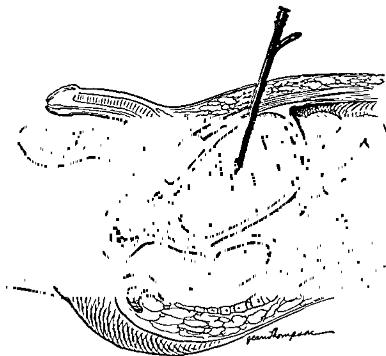


Fig 446—Trocar cystostomy (From Richards, V. Surgery for General Practice, St Louis, 1956, The C V Mosby Co)

Total Cystectomy

Definition.—Through a low transverse abdominal or midline incision the urinary bladder is removed. In the male, the prostate gland and seminal vesicles may or may not be removed, but the regional lymph nodes are removed.

General Considerations.—To treat an extensive carcinoma that has not infiltrated the entire bladder wall, with no evidence of distant metastasis, or a lesion that cannot be treated by radiation or partial cystectomy. A ureteral transplantation operation is usually done prior to or when the bladder is removed.[2, 11]

A total cystectomy is not performed if the tumor is beyond the bladder, or when the patient is a poor surgical risk.

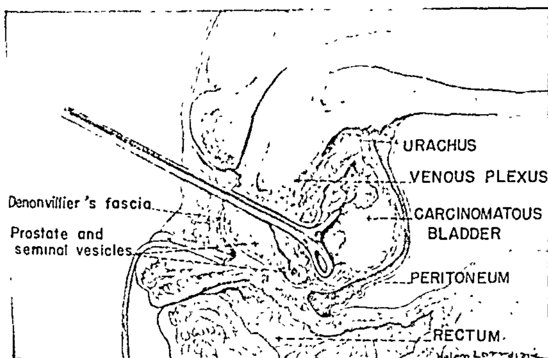


Fig 447.—Total cystectomy Illustrating important structures encountered From this point the operation may be completed from above or through the perineum (From Dodson, A. I: Urological Surgery, St Louis, 1956, The C V. Mosby Co.)

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for open surgery on the bladder, including special instruments listed for cystectomy and narrow deep detractors. Slight Trendelenburg position (Chapter 15), and skin preparation for a bladder operation. For combined abdominoperineal cystectomy, a suprapubic bladder setup, perineal prostatectomy setup, perineal pack, and items for lithotomy position are required. Cystectomy in the female patient requires an abdominal bladder setup; or if a vaginal approach is to be used a major perineal setup and bladder instruments are needed.

Operative Procedure (Suprapubic Approach).—

Steps	*Items*
1-5. As described for open cystostomy.	1-5. As described for suprapubic cystostomy

Steps	*Items*
6. The ureter transplantation is done if it has not been done previously.	6. As described for ureteral transplantation
7. The bladder is dissected free. The blood vessels are clamped and ligated (Fig 447).	7. Mayo-Harrington scissors, chromic gut No. 0 sutures, tissue forceps, moist saline packs, Deaver retractors
8. The urachus and its vessels are clamped, ligated, and divided.	8. Chromic gut No. 0, straight scissors, Carmalt hemostats, Rochester-Pean hemostats, Allis forceps, sponges on holders
9. The fundus of the bladder is lifted upward. The peritoneum is dissected free from the bladder.	9. Allis-Judd forceps, bladder retractor, Mayo-Harrington scissors, long tissue forceps, Kelly forceps, suction set
10. The seminal vesicles are removed with the bladder. The vas deferens is ligated and cauterized.	10. Aneurysm needle, chromic gut No 0, Crile hemostats, scissors, electrosurgical unit
11. The ureters have been previously divided; the stumps are removed with the bladder. The bladder is retracted and the vesical neck exposed and divided. The urethra is ligated and sutured. The bladder is dissected from the prostate.	11. Deaver and self-retaining bladder retractors, Allis forceps, scissors, suction set, Crile hemostats, chromic gut Nos. 2-0 and 3-0, needle holders, scalpel, scissors
12 The prostate gland might be removed by a perineal prostatectomy. The bladder is freed, the urethra doubly clamped and ligated, and the entire specimen removed.	12. Lithotomy position (Chapter 15), perineal prostatectomy setup including long curved and angled clamps, chromic gut No. 0, long curved scissors
13. The suprapubic wound is closed with drainage.	13. As described for suprapubic cystostomy

Segmental Resection of Bladder (Partial Cystectomy)

Definition.—Through a suprapubic midline, extraperitoneal, or combined abdominal peritoneal incision the diseased portion of the bladder is resected.

Considerations.—A portion of the bladder wall is excised to remove a neoplasm of the bowel which has become attached to the bladder, an early infiltrating tumor of the bladder, or chronic ulcers of the bladder and bladder diverticulum.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open suprapubic cystostomy, adding setup for implantation of radon or radium, if requested.

Operative Procedure.—

1. The bladder is exposed and freed from the surrounding tissue and the peritoneum.
2. If the growth involves that portion of the bladder which is covered by peritoneum, the peritoneum is excised in mass with the bladder segment.
3. The liver and retroperitoneal lymph nodes are palpated for metastasis. If the tumor involves the ureter, a neocystotomy may be done.
4. The vas deferens may be divided and ligated.
5. The bladder wall is closed in two layers with interrupted No. 0 chromic gut. Radium or radon may be implanted.
6. The bladder is drained suprapubically, as well as by an indwelling urethral catheter. A Penrose or soft drainage tube is placed in the prevesical and lateral vesical spaces.

Repair of a Vesical Fistula

Definition.—Closure of an abnormal communication between the bladder and an adjacent organ.

Vesicocutaneous Fistula

Definition.—Closure of a bladder opening and excision of the fistulous tract.

Considerations.—A vesicocutaneous fistula results generally from a persistent infection, lesion, or stone, or from an obstruction at the bladder neck or in the urethra. The fistula usually appears in the suprapubic region, perineum, or genital region.[1, 3, 6, 26]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the bladder, using the basic setup.

Operative Procedure.—Through a suprapubic incision the fistula is dissected free down to the bladder. The fascia and muscle are freed.

The fistula and scar tissue are excised from the bladder wall and the bladder closed. The suprapubic wound is drained and closed in layers. An indwelling catheter is inserted via the urethra for temporary drainage. Dressings are applied.

Vesicointestinal Fistula

Definition.—Repair of the diseased bowel, excision of the fistulous tract, and closure of the abnormal bladder opening.

Considerations.—A vesicointestinal fistula which permits direct communication between the bladder and the bowel usually results from inflammatory or cancerous lesion in the sigmoid colon and rectum. Trauma or other injuries involving the rectum may result in the formation of a fistula.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the kidney and ureter, including the ureterosigmoidostomy setup In some patients a preliminary colostomy is done and the bladder drained (cystostomy) to reduce the degree of infection and inflammation before the fistula is repaired.

Operative Procedure.—*Through an abdominal incision the diseased portion* of the bowel is dissected from the bladder and divided, and corrective surgery is carried out The bladder opening is closed, the bladder drained suprapubically, and the wound closed in layers.

Vesicovaginal Fistula

Definition.—Removal of the vaginal scar tissue and closure of the abnormal opening between the bladder and vagina.

Considerations.—A vesicovaginal fistula may result from accidental surgical trauma or a prolonged difficult labor or follow radiation therapy to treat a cancerous lesion of the cervix, or be due to an infection in the bladder or vagina [13, 14, 26, 29]

Surgical Approach.—The fistula may be repaired through a transvesical, transperitoneal, retroperitoneal, or vaginal approach. The type of approach will depend on the location of the abnormal opening and the structures involved.

Setup, Position, Skin Preparation, and Draping Procedure.—For vaginal approach, the patient is placed on the operating table in an extreme lithotomy or a prone position with the middle of the table elevated and the legs hyperextended. A vaginal preparation and anterior colporrhaphy setups are required (Chapter 15).

If a transperitoneal, retroperitoneal, or transvesical approach is used, a celiotomy setup is required (Chapter 15).

Operative Procedure.—

Through a Vaginal Approach.—The cervix is retracted downward, the scar tissue dissected away, and the vaginal mucosa freed. The bladder opening is closed, and the vaginal wound is closed by placing sutures in the vaginal borders and through the mucous membrane of the bladder.

Through a Suprapubic Incision.—The bladder is dissected free from the vaginal wall, and the bladder and the vaginal lesion are closed in layers with interrupted sutures Continuous bladder drainage is established (Fig. 445). In some cases, after completion of the operation, the patient is turned on the abdomen and placed on a hyperextension frame.

Diverticulectomy

Definition.—Through a midline or transverse low abdominal incision the diverticulum is isolated and handled by either extravesical or intravesical excision; the bladder defect is repaired and the wound drained.

Considerations.—A diverticulum is usually associated with an obstruction of the bladder neck due, in the male, to a prostatic enlargement or to a congenital urethral stricture. Such a condition causes the bladder muscle to atrophy due to the increased strain that it undergoes to remove the urine. The intravesical pressure forces the mucous membrane of the bladder to project itself between the muscle bundles in its wall, and this, in turn, creates a diverticulum. Because the diverticulum is without a muscular coat it does not empty, thereby permitting in-

fection and stones to develop. If the condition persists, the diverticulum may become large enough to bring pressure on one or both ureters. When the ureters become blocked they dilate, and this, in turn, causes pressure on the kidneys.[2, 10, 17]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for partial cystectomy.

Operative Procedure.—

1. The bladder wall is incised and opened, as for suprapubic cystostomy.
2. The diverticulum is drawn into the bladder for intravesical excision; then it is dissected free. The peritoneum, the vas, and the ureter are protected. In an extravesical excision the diverticulum is dissected free of all surrounding tissue; then excised.
3. The sac is clamped at its base and excised. The bladder wall is closed with interrupted chromic gut No. 0 or 2-0.
4. A Foley or Pezzer catheter is inserted into the bladder, and the wound is closed in layers as described for a suprapubic cystostomy.

Excision of Urethral Caruncle

Definition.—Removal of either a papillary or sessile growth in the urethral meatus.

Setup, Position, Skin Preparation, and Draping Procedure.—Minor dissecting setup, plastic dissecting instruments and sutures, and electrosurgical knife. The patient is placed on the operating table in a lithotomy position, and prepared and draped as for a perineal operation (Chapter 15).

Operative Procedure.—

For Removal of Papillary Growths.—The growth is exposed, clamped at its base with curved hemostats, and excised. A urethral indwelling catheter is inserted into the bladder. The wound is closed.

For Sessile Growths.—A circular skin incision is made around the meatus and carried through the submucosal layer. The urethra is freed from the caruncle, the meatus is dissected back to the healthy tissue, and the diseased portion of the urethra is excised The mucocutaneous junction is approximated with fine chromic gut sutures An indwelling urethral catheter is introduced and is kept in the bladder for at least five days.

Meatotomy (Urethra)

Definition.—Incision of a narrowed urethral meatus.

Purpose.—To relieve a stenosis of the urethral meatus.[2, 12, 30]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as listed for meatotomy. The male patient is placed in a supine position, and the glans penis elevated with a small support.

Operative Procedure.—

1. When a local anesthetic is used, a cotton applicator saturated with a 5 per cent cocaine solution is inserted into the urethral meatus. A small amount

of 2 per cent procaine solution is generally injected into the lower portion of the glans penis with a blub syringe having a blunt nose.

2. A hemostatic clamp is applied to the ventral surface of the meatus. An incision is made along the frenum down to the desired depth. The bleeding vessels are ligated with fine sutures.

3. Sutures may be placed on each side of the wound edges to approximate the mucosal layer of the urethra to that of the glans penis. Petrolatum gauze may be applied to the meatus.

4. The meatus is not dilated with sounds until about two weeks after surgery.

Circumcision

Definition.—An excision of the majority of the prepuce of the glans penis.

Purpose.—To relieve phimosis.[2, 12]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup listed for circumcision under open surgery on the urethra. The adult patient is placed on the operating table in a supine position (Chapter 4). Infants are usually wrapped in a sheet in such a way that their arms and legs are immobilized. The newborn infant may be secured to a padded board, using sheets and cotton. Care must be taken to permit adequate circulatory and pulmonary functioning. The scrotal region and penis are cleansed, using a mild soap, and the patient is draped with towels or a small fenestrated sheet.

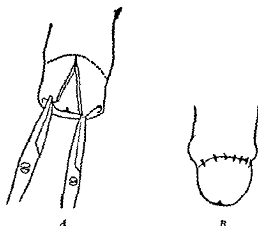


Fig 448—*A*, The first stage of circumcision on an infant. The dorsal incision is made and the dotted line shows the incision for removal of the prepuce *B*, The circumcision is completed. (From Dodson, A I. Urological Surgery, St Louis, 1956, The C V. Mosby Co)

Operative Procedure.—

Steps	*Items*
First Method.—	
1. If local is used, the Novocain solution is injected; encircling the base of the penis and deeper around the dorsal nerve.	1 Dakin tubing with a hemostat, 1 3 ml. Luer-Lok syringe, 1 hypodermic needle; 1 gauge 25, ¾ inch, 1 gauge 22, 1½ inches
2. The foreskin is brought forward over the glans penis and clamped obliquely.	2. 2 Allis forceps, circumcision clamp, or Kocher hemostat

Steps	*Items*
3. The portion of the skin and mucosa above the clamp is excised.	3. Knife or curved scissors, sponges
4. The mucous membrane of the foreskin covering the glans penis is exposed.	4. Gauze sponges, thumb forceps

Second Method.—

1. The mucosa of the foreskin is slit dorsally in the midline.	1. Scissors, tissue forceps, mosquito hemostats
2. The mucous edges are trimmed so as to leave a sufficient cuff of mucous membrane.	2. Curved scissors
3. The bleeding vessels are clamped and ligated.	3. Mosquito forceps, ligatures, plain gut No. 2-0, straight scissors
4. The cut edges of the mucous membrane are sutured to the cut edges of the skin. Sutures are tied over a narrow strip of petrolatum gauze packing.	4. Interrupted plain gut No. 2-0 swaged-on or threaded on straight skin needles
5. Dressings are applied to the wound surfaces.	5. Petrolatum gauze, 3 by 3 compresses (compresses cut in center, then placed over and around penis); 4 by 4 compress held over the first dressings by adhesive material

OPEN SURGERY ON THE PROSTATE GLAND

Setups

The standard setup for different types of prostatic operations should meet the preferences of the medical staff, and the items should be adequate and suitable for use on the involved structures.

The items needed for the various approaches include the following:

Suprapubic Prostatectomy.—As described for open surgery on the bladder, plus the following:

- Harrington or Judd-Masson self-retaining retractor
- Van Buren urethral sounds (Fig. 424)
- Foley catheter, desired size (Fig. 424)
- Suprapubic drainage tube (Fig. 444)
- Vasectomy setup, if desired

Retropubic Prostatectomy.—Similar to suprapubic prostatectomy setup.

Perineal Prostatectomy.—Hernial repair or minor setup for opening the abdominal wall, plus the following:

- 2 Kirwin, Horsley, or Young prostatic retractors, curved and straight, 9 inches (Fig. 448*A*)
- 2 Young lateral or Murphy narrow blades, 7¾ inches, or pliable ribbon, 13 inches

1 Young anterior retractor, wide blade, 7¾ inches (Fig. 449A)
1 *Young bifurcated retractor, small* or large, 7¾ inches, or Kraske 6-prong (Fig. 449A)
1 Nägeli posterior perineal, self-retaining retractor, if desired
1 Young Millen boomerang needle
1 Ellik bladder evacuator, optional
1 Electrosurgical unit with attachments
2 Young prostatic lobe-holding forceps, small and large
1 *Young prostatic* enucleator
1 Suction set elevator
1 Johnson prostatic needle holder, double-angled, 10¾ inches
1 Set urethral sounds
Urethral catheter, Robinson or whistle-tip No. 20 or 24 F
1 Hemostatic bag, desired type and size (Fig. 449B)

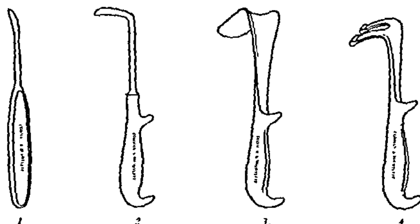


Fig 449A.—Young perineal prostatic instruments: *1*, Prostatic enucleator; *2*, prostatic lateral retractor; *3*, prostatic anterior retractor; *4*, prostatic bifurcated retractor. The instruments as shown are one third actual size. (Courtesy Codman & Shurtleff, Inc., Boston, Mass.)

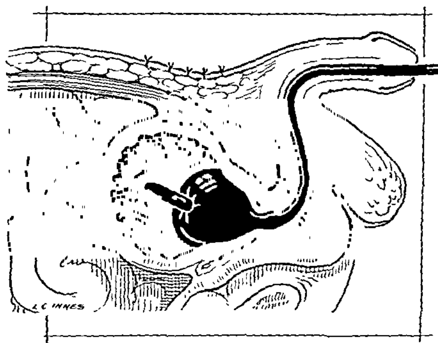


Fig 449B.—Hemostatic bag (Foley) which can be deflated and removed through the urethra It is used following most prostatectomies by any approach (From Barnes, R. W., and Hadley, H. L.: Urological Practice, St. Louis, 1954, The C V. Mosby Co)

Major perineal pack
Lithotomy sheet
Large regular sheet
Small regular sheet
Gown pack
Glove set
Antiseptic solution for irrigation
Specimen jars

Also

Drain pan and tray attached to operating table
Adjustable stools for operators
Plastic apron for operator
Cardiac arrest tray
Parenteral fluids and infusion set
Whole blood or plasma and transfusion set

Positioning the Patient, Skin Preparation, and Draping Procedure.—To perform a suprapubic prostatectomy the patient is placed on the operating table in a modified Trendelenburg position (Chapter 15). He is prepared as for an open bladder operation.[2, 9, 12]

To perform a perineal prostatectomy the patient is placed in an extreme lithotomy position (Chapter 15). In some hospitals a special table is used.[2]

Operations

Suprapubic Prostatectomy With Cystostomy

Definition.—Removal of the prostate gland through the bladder opening, and establishment of temporary drainage. A vasectomy may be done at the time of surgery.[1, 2, 12, 31]

Considerations.—A suprapubic operation is done when the prostate gland is large or when there is an enlarged prostatic gland with accompanying calculi, diverticula, or bladder tumors.[1,12,31,32] The true glandular hypertrophy consists of a multiplication and enlargement of glandular tissue in one or more lobes of the gland.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the bladder.

Operative Procedure.—The suprapubic approach and the enucleation of the prostate gland is shown in Fig. 450. The steps and items include the following:

Steps	*Items*
1-8. As described for suprapubic cystostomy. Vasectomy may be performed.	1-8. As described for suprapubic cystostomy-vasectomy setup
9. The opening in the bladder is extended, and the prostatic lobes are enucleated. Bleeding is controlled.	9. Self-retaining retractor, scalpel, Allis forceps, Pean and Crile hemostats, sponges on holders, small laparotomy pads
10. A hemostatic catheter is passed per urethra, the balloon adjusted in the prostatic fossa under direct vision and inflated A small black tube or open Pezzer catheter or Freyer tube may be inserted through the bladder wall.	10. Foley, Pilcher, or Hagner hemostatic catheter, desired size, and desired tube or catheter

1 Young anterior retractor, wide blade, 7¾ inches (Fig. 449*A*)
1 Young bifurcated retractor, small or large, 7¾ inches, or Kraske 6-prong (*Fig. 449A*)
1 Nageli posterior perineal, self-retaining retractor, if desired
1 Young Millen boomerang needle
1 Ellik bladder evacuator, optional
1 Electrosurgical unit with attachments
2 Young prostatic lobe-holding forceps, small and large
1 Young prostatic enucleator
1 Suction set elevator
1 Johnson prostatic needle holder, double-angled, 10¾ inches
1 Set urethral sounds
Urethral catheter, Robinson or whistle-tip No. 20 or 24 F
1 Hemostatic bag, desired type and size (Fig. 419*B*)

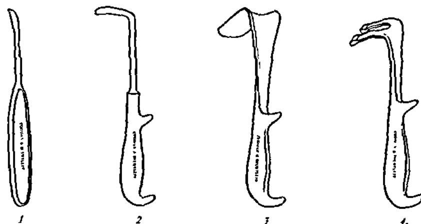


Fig 449*A* —Young perineal prostatic instruments. *1*, Prostatic enucleator; *2*, prostatic lateral retractor, *3*, prostatic anterior retractor, *4*, prostatic bifurcated retractor. The instruments as shown are one third actual size. (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

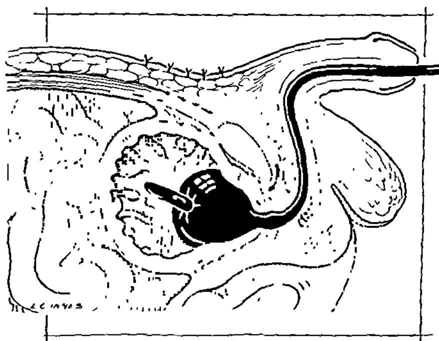


Fig. 449*B*.—Hemostatic bag (Foley) which can be deflated and removed through the urethra It is used following most prostatectomies by any approach (From Barnes, R. W, and Hadley, H. L.: Urological Practice, St Louis, 1954, The C. V. Mosby Co)

Operative Procedure.—

1. Through a vertical or transverse suprapubic incision the abdominal wall is opened and the space of Retzius exposed. The bladder is not opened.

2. The prostatic capsule is incised transversely and the gland dissected free and enucleated (Fig. 451). The bleeding points are clamped and ligated or fulgurated by electric coagulation. A wedge-shaped piece of tissue is excised from the vesical neck.

3. A Foley catheter is inserted through the urethra into the bladder.

4. The prostatic capsule is tightly closed with interrupted sutures of chromic gut No. 0. A Penrose or cigarette drain is inserted down to the prostatic cavity. The incisional wound is closed in layers as described for suprapubic cystostomy.

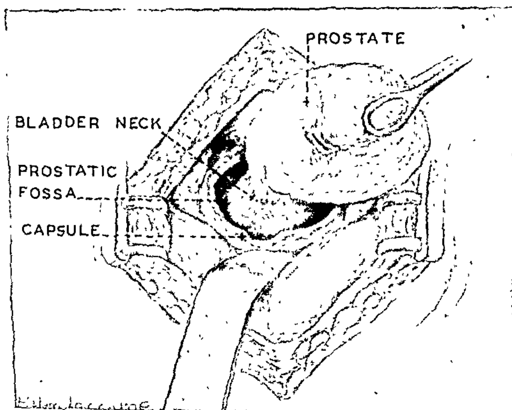


Fig. 451.—Retropubic prostatectomy. Prostate ready to be liberated from the vesical neck which is exposed through an incision made just below the umbilicus and extending downward over the symphysis pubis, or through a Pfannenstiel incision (From Dodson, A. I: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

Radical Retropubic Prostatectomy

Definition.—A radical retropubic prostatectomy includes the removal of the capsule and the gland, with a portion of the bladder trigone, and the seminal vesicles.

Purpose.—This operation may be done to treat a carcinoma of the prostate when there is no evidence that the lesion has extended beyond the prostatic capsule.[33]

Steps	*Items*
11. One or two cigarette or Penrose drains are usually placed in the prevesical space (of Retzius).	11. Soft rubber tube or Penrose drain, tissue forceps
12. The wound is closed in layers and dressings are applied.	12. As described for suprapubic cystostomy

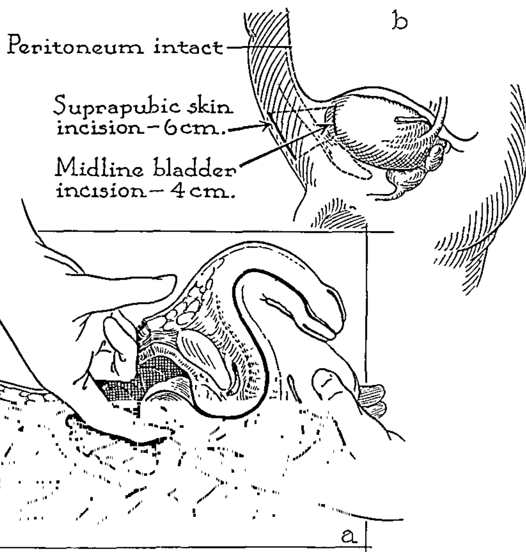


Fig. 450—Enucleation of the prostate by the suprapubic approach. (From Barnes, R. W., and Hadley, H L Urological Practice, St. Louis, 1954, The C. V Mosby Co)

Simple Retropubic Prostatectomy

Definition.—Through a suprapubic incision the prostate gland is exposed through the space of Retzius.

Considerations.—A retropubic prostatectomy may be preferred in the presence of an intraurethral prostatic enlargement or a large lesion.[12,31,33]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for suprapubic prostatectomy.

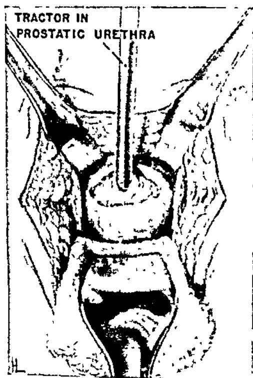


Fig. 454 —Urethrotomy in prostatic urethra.

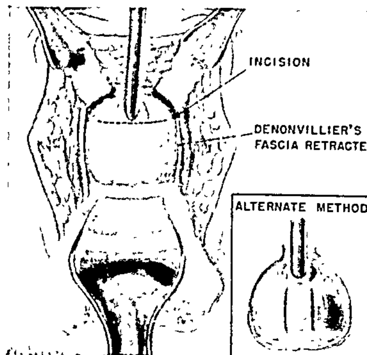


Fig. 455 —Incision in prostatic capsule.


Fig 456 —Enucleating the entire prostate with aid of finger.

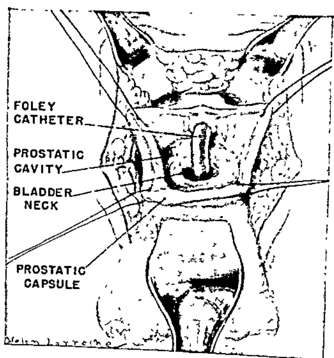


Fig 457 —Catheter in urethra and bladder, exposure of prostatic bed.

The vesical neck is sutured to the urethra; a Foley catheter is inserted through the urethra and into the bladder. The incisional wound is closed in layers without drainage.

Setup.—As for simple prostatectomy

Operative Procedure.—Similar to simple prostatectomy.

Simple Perineal Prostatectomy

Definition.—Removal of the prostate gland through an inverted U or a curved perineal incision.

Considerations.—This type of prostatectomy may be preferred by physicians who have found it to be a successful method.[2, 12, 31]

Setup, Position, Skin Preparation, and Draping Procedure.—The setup as listed previously for perineal prostatectomy. The patient is placed on the operating table in an extreme lithotomy position. A special table may be used whereby the perineal region will be parallel with the rest of the body. The operative region is elevated with a sandbag or a thick sponge-rubber pad.

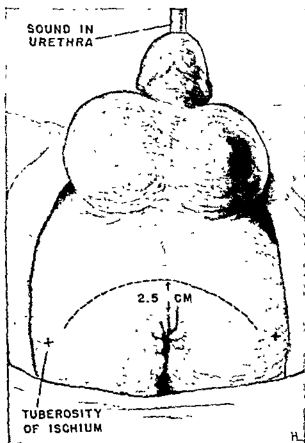


Fig. 452

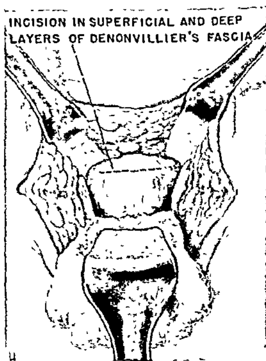


Fig. 453

Figs 452-459—Perineal prostatectomy (From Dodson, A. I: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

Fig. 452.—Proposed incisional site

Fig. 453.—The rectourethralis has been incised and pushed downward from the central tendon, and levator ani muscles on each side have been divided, the incision in the superficial and deep layers of Denonvilliers' fascia is shown

Steps	*Items*
2. The levator ani muscles are exposed and retracted; the rectourethralis fibers are divided. A longitudinal incision is made over the sound or instrument in the prostatic urethra. The vesical orifice is dilated and the bladder retracted.	2. Posterior prostatic retractors, scalpel, sponges on holders, Allis forceps, ligatures and scissors, Young or Lowsley prostatic retractor, small moist laparotomy pad
3. A transverse incision is made at the apex of the prostatic gland; the fascia and prostatic capsule are incised.	3. Posterior retractor, gauze sponges, scissors, blunt dissector and scalpel
4. The prostate gland is removed by closing the blades of the prostatic tractor. Hemostasis is completed. An indwelling catheter is inserted into the bladder. The levator ani muscles are approximated with sutures. A drain is inserted into the wound cavity; the fascia, subcutaneous tissue, and skin edges are approximated with sutures. Perineal dressings are applied.	4. Prostatic tractor, Mayo-Pean hemostats, chromic gut No. 2-0 and 3-0, scissors, Foley catheter, desired size, chromic gut No. 2-0 or 0, Mayo needle holder, tissue forceps, scissors, sponges on holders, Penrose drain, sutures chromic gut No. 2-0 or 3-0, fine wire or silk skin sutures, perineal dressing, binder, and support

Radical Perineal Prostatectomy

Definition.—Through a perineal approach the entire prostatic gland with capsule, a portion of the bladder, and the seminal vesicles are removed.

Considerations.—A radical perineal prostatectomy is indicated when a suspected carcinoma of the prostate is established by a biopsy examination.[2]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for perineal prostatectomy.

Operative Procedure.—The prostate gland is exposed and removed, as described for perineal prostatectomy. After removal of the prostatic capsule and gland and a segment of the bladder, the neck of the bladder is sutured to the urethra. An indwelling catheter is inserted. The incision is closed and drainage is established.

OPEN SURGERY ON THE SCROTUM AND ITS CONTENTS

The anatomy and physiology of the reproductive organs in the male have been described previously in this chapter (Figs. 420 and 422).

Setup

For different types of surgery on the scrotum, epididymis, testicle, vas deferens, and spermatic cord, the setup should be listed in the operating room procedure book.

The knees are flexed and the legs supported by stirrups slanted backward to relieve strain on the spinal nerves; the back should be supported with bags and the buttocks should rest on the operating table (Chapter 4).

The bladder is irrigated with an antiseptic solution, and the external genitals are cleansed with a mild detergent and painted with a germicide (Chapter 3). The proposed operative site is draped with towels. A sound, No. 22 or 24 F, or a Lowsley seminal vesical retractor is introduced into the penis and directed into the bladder. The instrument is removed when the prostatic urethra has been exposed. The patient is draped with a fenestrated perineal sheet having a suitable opening.

Operative Procedure.—The Dodson method for perineal prostatectomy is shown in Figs. 452 to 459. The major steps include the following:

Steps	*Items*
1. Through a curved incision made just above the anal margin, the skin, fat, and subcutaneous fascia are divided. The tissue on either side of the central tendon is dissected, the tendon divided transversely, and the fascia of Denonvilliers exposed.	1. Scalpel, gauze sponges, Allis forceps, narrow-angled retractors, Mayo-Pean curved hemostats, electrocoagulation unit and ball-type electrodes, tissue forceps with teeth, curved dissecting scissors

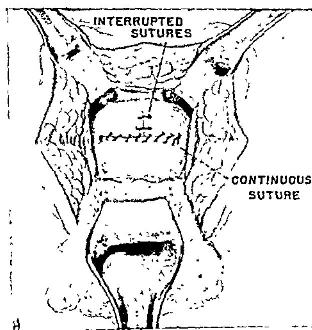


Fig 458 —Closure of inverted-T incisions

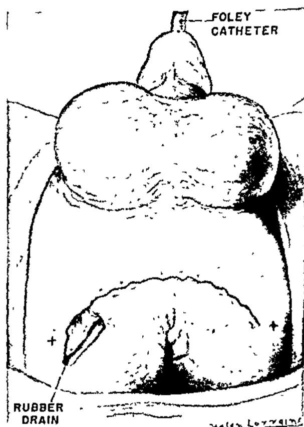


Fig 459 —Closure of perineal wound.

6 Towels
1 Fenestrated sheet or 2 regular sheets
1 Gown set
1 Glove set
12 Gauze compresses, 3 by 3 inches
4 Cotton-tipped applicators

Sutures

1 Chromic gut No. 3-0 or 4-0
1 Chromic gut No. 2-0 or 0
1 Wire or nylon skin suture No. 5-0 swaged-on needles

Position, Skin Preparation, and Draping Procedure

The patient is generally placed on the operating table in a supine position (Chapter 4). The external genital and the lower pubic region are cleansed and a mild germicide is applied (Chapter 3). Towels are placed around the prepared scrotum and pubic region, and the patient is draped with a fenestrated sheet (Chapter 4).

Operations

Repair of Hydrocele (Hydrocelectomy)

Definition.—Removal of the fluid from the tunica vaginalis of the testicle, and excision of the tunica vaginalis propria. The opened sac may be plicated.

Considerations.—The operation is done when the amount of hydrocele fluid, normally present between the covering of the testicle and the scrotal lining, has increased and is also present within the tunica vaginalis. This condition may occur because of a low-grade chronic infection or following an acute infection due to mumps or trauma. The fluid may disappear when the disease or trauma has been controlled.[3, 9, 12]

A dressing or support should be applied in such a way that it will remain in place and prevent excessive postoperative swelling of the tissues. The Keyes dressing may be used by placing a gauze roll or bandage against the perineum and holding it in position by adhesive tape. The scrotum may be supported by a bridge of adhesive tape placed across both upper thighs before the dressings are applied. During the ambulatory period the dressings are held in place by a suspensory or athletic supporter.

Purpose.—To destroy the secreting cells so that the vesical layers will adhere to the nonserous membrane that encloses the testicle, thereby controlling the amount of fluid.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the scrotum, and, in some cases, a small folded sheet may be placed beneath the scrotal region. Four surgical towels are placed around the cleansed scrotal region, and the patient is draped with a fenestrated sheet.

Operative Procedure.—The type of incision is shown in the illustration for hydrocelectomy (Fig. 460).

Steps	*Items*
1. The scrotal mass is held, and the skin and dartos over the anterolateral surface are incised, a distance of three or more inches	1. Scalpel, tissue forceps, sponges, Crile or Rankin hemostats, Providence hemostats, ligatures, plain or chromic gut No. 2-0 or 3-0, suture scissors

For operations such as epididymectomy, orchidectomy, hydrocele repair, orchidopexy, varicocelectomy, and undescended testicle, the basic setup should include the following:

Instruments

- 2 Volkman or Murphy 2-prong blunt retractors, 8½ inches, optional
- 2 Roux or Parker retractors, 1-inch blade, 7 inches
- 2 Greene retractors, blade ½ inch wide by 1 inch deep, and 8½ inches, optional
- 4 Foerster sponge-holding forceps, 9¾ inches
- 2 Murphy-Pean forceps, 6½ inches
- 6 Backhaus towel forceps
- 3 Scalpels, 2 handles No. 4 and blades Nos. 10, 15, and 20
- 1 Metzenbaum scissors, curved, 7 inches
- 6 Providence or Kelly hemostats, curved, 5¼ inches
- 16 Crile or Rankin hemostats, straight, 6½ inches
- 6 Rochester-Pean hemostats, curved, 6¼ inches
- 2 Ochsner forceps, straight, 6¼ inches, optional
- 4 Allis-Adair forceps, 6 inches
- 4 Allis forceps, 6 inches
- 2 Babcock forceps, 6 inches, optional
- 1 Probe and grooved director
- 3 Tissue forceps with teeth—2, 5½; 1, 7½ inches
- 3 Tissue forceps without teeth—2, 5½; 1, 6¼ inches
- 1 Deschamps or Crile ligature carrier, curved, right or left, blunt-point, 8 inches
- 2 Mayo-Hegar needle holders, 6 inches

Aspirating needle and syringe set

- 1 Ochsner trocar and cannula No. 20 F, optional
- 1 Suction cannula and rubber tubing
- 2 Skin hooks
- 16 Michel or autoclip skin clips and holders, optional

Sutures

Plain or chromic gut No. 3-0 for ligatures
Chromic gut Nos. 2-0 and 0 for wound closure
Chromic gut Nos. 2-0 and 3-0 swaged-on fine needles for repair
Murphy needles No. 3
Mayo needles No. 3 or 4
Surgeon's needles ⅜-circle cutting-edge No. 6
Keith needles

Textiles

Major or minor operating pack
Fenestrated sheet
Gauze sponges, small size if desired
Laparotomy pads, small size
Glove set
Gown set

Also

Basin set
Electrosurgical unit and attachments
Suspensory support

For Vasectomy.—The setup should include the following:

Instruments

- 2 Mayo-Collins retractors
- 2 Roux or Parker retractors
- 2 Scalpels with blade No. 20
- 2 Tissue forceps without teeth
- 2 Tissue forceps with teeth
- 4 Crile hemostats, straight
- 4 Kelly hemostats, curved
- 4 Allis forceps
- 1 Mayo scissors
- 1 Metzenbaum scissors
- 1 Suture scissors
- 4 Sponge-holding forceps
- 1 Aspirating needle, gauge 16
- 1 Syringe, 20 ml.
- 1 Asepto syringe

Textiles

- 1 Minor basin set

Steps	*Items*
2. The external spermatic fascia, the cremasteric fascia, and internal fascia layers are incised. Bleeding vessels are clamped and ligated.	2. Fresh scalpel, Crile hemostats, Volkmann retractors, Rochester-Pean hemostat, Allis-Adair forceps, sponges, Mayo scissors, chromic gut No. 2-0
3. The spermatic fascia is retracted, the tunica vaginalis sac delivered, and the testicle exposed.	3. Roux or Greene retractors, sponges on holders, Metzenbaum scissors, Providence hemostats
4. If the hydrocele is large the scrotal sac is retracted and the fluid aspirated; then the puncture wound is clamped.	4. Ochsner trocar, or aspirating needle and syringe, suction set, Rochester-Pean hemostat
5. The adherent tunica vaginalis is separated from the internal fascia and the sac opened.	5. Metzenbaum scissors, tissue forceps, sponges, knife, Allis forceps, Babcock forceps
6. The cavity is dissected free and the tunica vaginalis trimmed; the bleeding vessels are clamped and ligated, then the testicle is returned to the scrotal sac.	6. Mayo straight or Metzenbaum scissors, Crile and Kelly hemostats, sponges on holders, free ligatures and suture ligatures of chromic gut No. 2-0 or 3-0 fused to fine curved needles
7. The wound is closed and a drain may be inserted. Dressings and a suspensory are applied.	7. Penrose drain, tissue forceps, interrupted sutures of chromic gut No. 2-0 or 3-0 and silk or nylon No. 4-0 or 5-0, dressings, and suspensory

Orchidectomy

Definition.—Removal of testis. When both testes are removed the operation is known as castration.

Considerations.—Unilateral orchidectomy is occasionally done to treat trauma or thrombosis of a testicle; a bilateral orchidectomy is often done to control carcinoma of the prostatic gland.[2, 12] The patient or his guardian is usually required to sign the operation permission form. In caring for the equipment postoperatively, terminal disinfection technique is followed if the patient has a tuberculous lesion (Chapter 2).

Setup, Position, Skin Preparation, and Draping Procedure.—As for open surgery on the scrotum. A narrow cotton tape is needed to retract the cord.

Operative Procedure.—

Steps	*Items*
1. An elliptical incision is made in the upper anterior surface of the scrotum and carried through the skin, dartos, and fascial layers, exposing the tunica vaginalis.	1. Scalpel, sponges, Kelly and Crile hemostats, tissue forceps, scissors, ligatures, chromic gut No. 4-0 or plain gut No. 3-0, Greene retractor

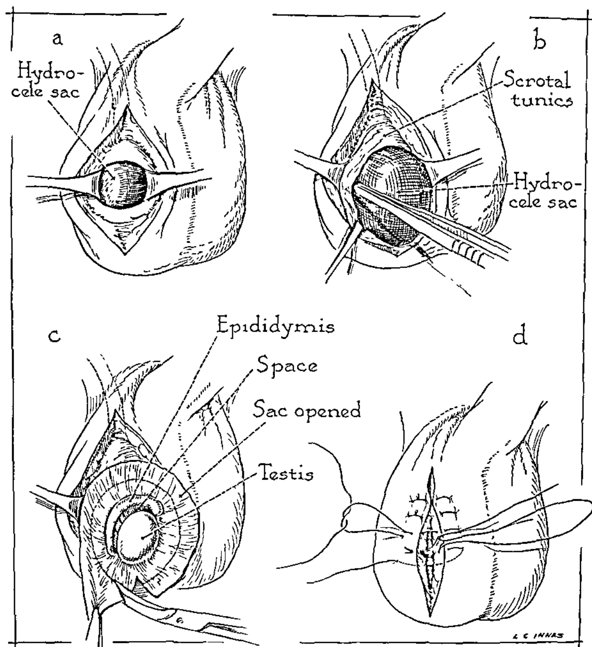


Fig. 460.—Hydrocelectomy *a*, Incision through the anterior scrotum, exposing the hydrocele sac. The characteristic dark blue shiny appearance of the tunica vaginalis, which is the sac wall, is due to the deep shadow within the sac. *b*, Hydrocele sac enucleated and removed from the scrotum It is left attached to the groin by the spermatic cord *c*, Sac opened and excised from testicle *d*, Skin edges and subcuticular tissues approximated with single mattress sutures of No. 3-0 plain catgut. (From Barnes, R W, and Hadley, H L Urological Practice, St. Louis, 1954, The C V Mosby Co)

Purpose.—To correct a congenital condition known as cryptorchidism or undescended testis.[2,12,14,17]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the scrotum. The setup should consist of small-sized instruments and sutures suitable for use in young children. For a bilateral operation extra items are added as described for bilateral hernial repair (Chapter 11).

Operative Procedure.—One of several types of operations may be selected to correct cryptorchidism. The Torek operation, which is popular, may be done in one stage or in two stages if the spermatic cord is too short to bring the testicle down to its normal position in the scrotal sac.

Torek Operation.—

Steps	*Items*
1. *First Stage:* An incision is made in the inguinal region to expose the inguinal canal. The spermatic cord is identified and freed from its surrounding tissue. (Fig. 461.)	1. As described for inguinal hernial repair (Chapter 11), using fine instruments, small-sized gauze sponges, and draping sheets

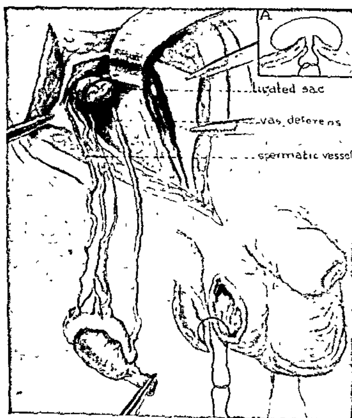


Fig. 461.—The Torek method of orchidopexy The hernia sac has been removed and the stump ligated The cord has been freed of adhesions until the testicle can be brought into the scrotum The scrotum has been prepared and incisions are made in the scrotum and skin of the thigh preparatory to suturing the testicle to the fascia lata. Inset shows method of suturing posterior edge of scrotal wound to that of thigh so that skin margin will turn out. (From Dodson, A. I: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

Steps	*Items*
2. The scrotal segments are retracted and the tunica vaginalis is grasped and incised.	2. Greene or Parker retractor, Allis-Adair forceps, Crile hemostats, scalpel, scissors, tissue forceps with teeth, moist gauze sponges
3. The spermatic cord up to the external abdominal ring is isolated, the spermatic sheath is incised, and the cord structures are exposed, clamped, and incised; the upper end of the cord is doubly ligated.	3. Mayo curved scissors, scalpel, tissue forceps, Mayo-Pean hemostat, Allis forceps, Babcock forceps, moist sponges on holders; ligatures, chromic gut No. 2-0; cutting electric current may be used to remove a tumor
4. The testicle is delivered into the wound, and the testicle is removed. The bleeding vessels are ligated; a small soft rubber tissue drain is inserted in the wound, which is closed with sutures. Dressings are applied.	4. Curved Kelly hemostats, Crile hemostats, Metzenbaum scissors, tissue forceps; fine-gauged ligatures, interrupted chromic gut sutures No. 2-0 and 3-0 swaged-on small ½-circle taper-point needles, needle holders, tissue forceps, Kelly hemostats, scissors; interrupted skin sutures, nylon No. 5-0 or wire No. 6-0, gauze compresses, scrotal bandage or suspensory

Epididymectomy

Definition.—Removal of the epididymis without injury to the testis.

Purpose.—To treat a persistent infection such as tuberculosis of the epididymis. In most cases antibiotic therapy is the preferred plan of treatment.[2, 12]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the scrotum. In caring for soiled equipment, terminal disinfection is carried out (Chapter 2).

Operative Procedure.—

Steps	*Items*
1. An incision is made in the skin and extended down to the tunica vaginalis	1. As described for repair of hydrocele
2. The tunica vaginalis is incised; the testis and epididymis are exposed.	2. Scalpel, Metzenbaum scissors, Kelly hemostats, moist opened gauze sponges
3. An incision is made between the upper pole of the epididymis and the testis. The epididymis is removed. The wound is closed with sutures and dressed.	3. Scalpel, moist gauze forceps, fine-toothed tissue forceps, chromic gut No. 4-0 swaged-on intestinal needle, nylon or silk No. 4-0 or 5-0, gauze dressings

Orchidopexy

Definition.—Transplantation of an undescended testicle, usually from the inguinal canal or abdomen into the scrotal sac.

Steps	*Items*
5. The wounds in the thigh and scrotum are sutured together. If a hernia is present, a herniorrhaphy is done.	5. Silk Nos. 3-0 and 4-0 swaged-on curved intestinal needle, needle holder; sutures as described for hernial repair using silk Nos. 3-0, 4-0, and 5-0
6. *Second Stage:* The scrotum is freed from the thigh; the testicle dissected free from the fascial layers of the thigh.	6. Retractors, scalpel, tissue forceps, scissors, Halsted hemostats, silk Nos. 5-0 and 4-0
7. The wounds of the scrotum and thigh are closed, and dressings are applied (Fig. 463).	7. Silk Nos. 3-0 and 4-0 swaged-on intestinal and cutting-edge needles, needle holders, gauze dressings

Bilateral Orchidopexy.—The operation may be done in three stages. In the first stage one testicle is brought down and secured to the thigh; in the

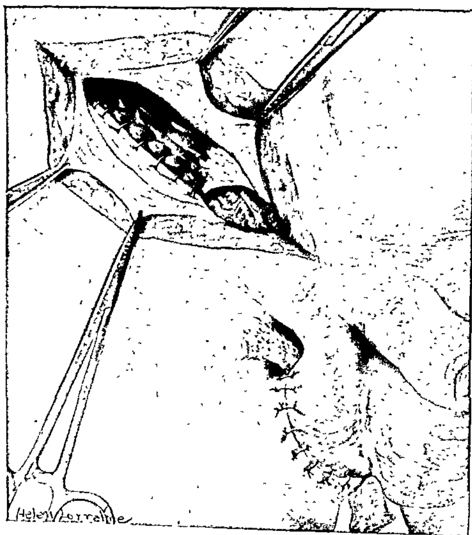


Fig 463 —The Torek method of orchidopexy—cont'd The anterior lip of the scrotal wound has been sutured to that of the thigh, securely covering the testicle. Closure of the abdominal wound completes the operation. The testicle is separated from the thigh three or four months later. (From Dodson, A I Urological Surgery, St Louis, 1956, The C V. Mosby Co)

Steps	*Items*
2. The sac of the tunica vaginalis is opened; the testicle is freed from the spermatic cord; the vas deferens and the spermatic artery are dissected free from surrounding fibrous structures. The testicle is *brought down into the scrotal sac.* (Fig. 462.)	2. Suitable retractors, scalpel, Metzenbaum scissors, Babcock forceps, Allis-Adair forceps, Halsted and Kelly hemostats, tissue forceps with fine points and teeth, chromic gut No. 4-0 or silk Nos. 3-0 and 4-0, suture scissors, small moist laparotomy pads, Penrose tubing for traction
3. An incision is made in the lower portion of the scrotal sac. Another incision is made on the inner aspects of the thigh opposite the scrotal incision, extending through the pectineus fascia.	3. Scalpel, small retractors, Halsted and Kelly hemostats, silk No. 4-0 or 5-0 for ligatures, suture scissors, Metzenbaum scissors, tissue forceps, Allis or Babcock forceps
4. The gubernaculum of the testicle and the lateral aspect of the scrotal sac are attached to the upper medical aspects of the pectineus fascia of the thigh.	4. Silk No. 3-0 or 4-0, swaged-on curved intestinal needle, needle holder, tissue forceps, moist small sponges on holders, small laparotomy pads

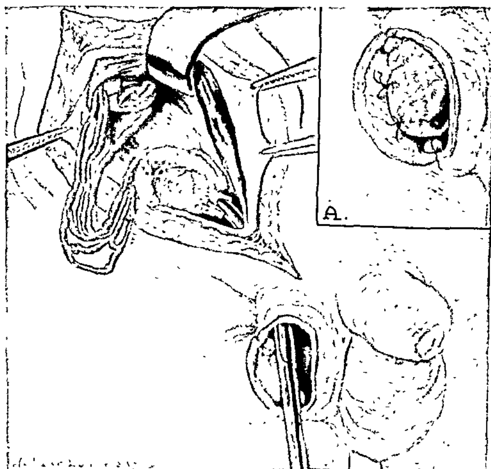


Fig 462—The Torek method of orchidopexy—cont'd Forceps inserted through the scrotal nd pull the testicle in place Inset *A* shows the interrupted fascia lata Some surgeons, for fear of injuring the testicle, to the fascia lata (From Dodson, A. I: Urological Surgery, St. Louis, 1956, The C. V. Mosby Co)

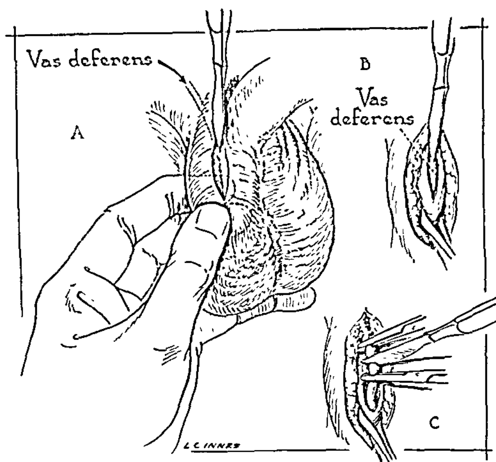


Fig. 464.—Vasectomy (vas ligation). *A*, Vas is grasped between the thumb in front and the first and second fingers behind. An incision 2 cm. long is made over the vas. *B*, Vas grasped with Allis clamp and incision deepened into it. *C*, Vas clamped with two hemostats and incised between them. (From Barnes, R. W., and Hadley, H. L.: Urological Practice, St. Louis, 1954, The C. V. Mosby Co.)

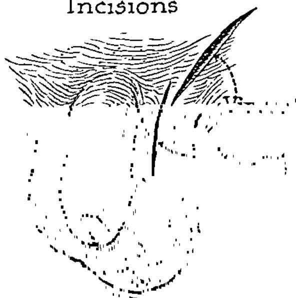


Fig. 465.—Types and location of optional incisions commonly used for varicocelectomy. (From Manual of Operative Procedure, Ethicon Suture Laboratories, Inc., Somerville, N. J.)

second stage the first testicle is released from the thigh, and the second testicle is brought down to the thigh. In the third stage the second testicle is released.

Modified Bevan Orchidopexy.—During this operation a purse-string suture of chromic gut No. 0 is taken at the level of the inguinal scrotal junction.

Bilateral Vasectomy

Definition.—Removal of a portion of the vas deferens on either side.

Purposes.—To treat recurrent epididymitis, or to prevent its occurrence following a prostatectomy operation, or as a means of birth control.[12]

Setup, Position, Skin Preparation, and Draping Procedure.—A minor setup as listed previously in this chapter. The patient is prepared as for open surgery on the inguinal region:

Operative Procedure.—

Steps	*Items*
1. A vertical incision is made in the upper scrotal region over the spermatic cord. The incision is extended through the fascia down to the spermatic sheath. (Fig. 464.)	1. Scalpel, Volkman blunt retractors, gauze sponges, tissue forceps, Crile hemostats, Allis or Allis-Adair forceps, clean scalpel, Mayo hemostat, Mayo scissors, Greene retractors, moist sponges on holders
2. The spermatic cord and its coverings are isolated from the surrounding fat.	2. Mixter or Metzenbaum scissors, Pean hemostat, Kelly or Crile hemostats, chromic or plain gut No. 3-0, straight scissors
3. The cord is delivered into the wound, the layers of spermatic sheath are incised, and the vas deferens is dissected free from the adjoining vessels.	3 Scalpel with fine blade, Crile or Kelly hemostats, Allis forceps, moist sponges on holders
4. A segment of the vas deferens is grasped, doubly clamped, and ligated at both extremities of the incision, and the portion between the ligatures is excised.	4. Allis forceps, Mayo or Crile hemostats, ligatures, chromic gut No. 0 or silk No. 2-0, straight scissors, knife
5 The bleeding vessels are clamped and ligated. The wound is closed without drainage.	5 Kelly hemostats, Allis forceps or skin hooks, ligatures and sutures, chromic gut or silk Nos. 3-0 or 4-0, straight scissors, needle holders, tissue forceps, silk No. 4-0 or 5-0 for skin.
6. The above procedure is carried out on the other side. Dressings are applied to the wounds.	6. Scalpel and other items as for Steps 1 to 5; gauze or cotton dressing and collodion

Varicocelectomy

Definition.—Ligation and possible excision of varicose veins associated with the spermatic cord.

examination. The number and kind of items to be prepared will depend upon the number and type of examinations to be done within a six-hour period.

Equipment for Skin Preparation.—

Mild soap and water, or detergent
Sterile water in a pitcher
Cotton swabs
Gauze sponges

Equipment for Examination and Tests.—

Urethral syringe, blunt nose } for topical anesthetic
Pontocaine solution, 2 per cent } for topical anesthetic
Metal pan (12 inches wide, 18 or 20 inches long, and 6 inches deep) containing cold sterile distilled water
Bulb syringe, 1 ounce, with blunt nose for male patient, tapered end for female patient
Gauze compresses, 4 by 4 inches
Cotton balls
Cotton-tipped applicators
Safety pins
Lubricating jelly
Asepto syringe, 30 ml.
Test tubes or bottles labelled right and left for collecting urine specimen from kidneys
Test tube holder
Glass pencil and marker
Round metal basin containing sterile distilled water
Kidney basin for collecting urine from female patient
Ureteral catheters, desired size
Set of urethral sounds
Urethral catheters, desired sizes and types (Robinson and Foley)
Wire basket
Biopsy forceps, desired type
Mayo scissors, straight
Mayo-Rochester hemostat, curved
Towel forceps
Irrigating setup, including
- 2-5 gallon receptacle secured from ceiling or floor standard
- Sterile water at 92° to 98° F.
- Plastic tubing
- Clamp
- Connector

Brown-Buerger or Braasch cystoscope, desired size, i.e., No. 24 or 28 F for adult (Fig. 466)
Sterile gloves and gowns
Sterile towels and perineal sheet
Antiseptic solution for irrigation

Also

Battery (dry cell) box or transformer
Stools
Plastic apron

For Ureteral Catheterization and Kidney Function Test, add the following:

2 Catheterization telescopes for cystoscope
2 Rubber tips, without hole
2 Rubber tips, with hole
2 Ureteral catheters, i.e., whistle-tip No 6 or 7 F
2 Stoppers for ureteral catheters
2 Connecting tips for ureteral catheters
4 Test tubes, labelled or marked
2 Syringe, 30 ml.
Opaque media, i.e., phenolsulfonphthalein and sodium carbonate, or indigo carmine
Sensitivity testing setup, i.e., Neo-Synephrine 0.25 ml. (0.5 mg.), 2 ml. syringe and hypodermic needle

For Retrograde Pyelography, add the following:

1 Ureteral catheterization setup
2 Glass burets with rubber tubes
2 Adapter tips for ureteral catheters or 2 syringes, 30 ml., with adapters
50 ml. of Skiodan (10 or 20 per cent) or Diodrast (30 *per cent*) *solution*

Considerations.—This operation is seldom done.[2, 12]

Purpose.—To relieve persistent pain that results from a dragging sensation in the redundant scrotum due to pressure of the enlarged veins.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the scrotum.

Operative Procedure.—The types and location of incisions are shown in Fig. 465.

Steps	*Items*
1. An incision is made in the lower inguinal region or in the upper portion of the scrotum. The spermatic cord is identified. The arteries and varicosed veins are dissected free from the vas deferens.	1. Scalpel, tissue forceps, Kelly hemostats, chromic gut No. 5-0 or silk No. 4-0, suture scissors, small retractors, moist gauze compresses, Allis forceps
2. The excess vessels are clamped and doubly ligated at the points to be sectioned. The portion of the veins between the ligatures and hemostats are removed.	2. Crile or Mayo hemostats, silk or chromic gut No. 0 or 2-0, scissors
3. To provide support to the testicle, the distal ends of the resected veins are approximated and secured to the external oblique fascia at a point above the external inguinal ring. The proximal vascular stumps are allowed to retract into the inguinal canal. The wound is closed with or without drainage.	3. Needle holder and curved Murphy needle for threading ends of ligatures, moist gauze sponges, scissors; sutures as for scrotal wound closure, Penrose tubing if desired

CYSTOSCOPY AND TRANSURETHRAL SURGERY

Cystoscopy and Tests

Definition of Terms.—A simple cystoscopy includes a visual inspection of the interior of the urethra, the bladder, the ureteral orifices, and the bladder neck by introduction of instruments

A complete cystoscopy includes visual inspection of the urethra and bladder, removal of a specimen from the kidneys by means of ureteral catheters, and retrograde injection of radiopaque fluid followed by x-ray studies.

Purpose.—To aid the physician in diagnosing abnormalities and lesions of the genitourinary tract[34]

Setup.—When several cystoscopies and tests are to be done in succession, the instruments and other items should be arranged on a sterile instrument table of the proper height. The sterile equipment needed for each procedure is arranged on a portable stand which is placed near the operator. The remaining pieces of equipment on the sterile table are not contaminated. Sterile transfer forceps are used to take instruments from the stock table during an

examination. The number and kind of items to be prepared will depend upon the number and type of examinations to be done within a six-hour period.

Equipment for Skin Preparation.—

Mild soap and water, or detergent
Sterile water in a pitcher
Cotton swabs
Gauze sponges

Equipment for Examination and Tests.—

Urethral syringe, blunt nose } for topical anesthetic
Pontocaine solution, 2 per cent } for topical anesthetic
Metal pan (12 inches wide, 18 or 20 inches long, and 6 inches deep) containing cold sterile distilled water
Bulb syringe, 1 ounce, with blunt nose for male patient, tapered end for female patient
Gauze compresses, 4 by 4 inches
Cotton balls
Cotton-tipped applicators
Safety pins
Lubricating jelly
Asepto syringe, 30 ml.
Test tubes or bottles labelled right and left for collecting urine specimen from kidneys
Test tube holder
Glass pencil and marker
Round metal basin containing sterile distilled water
Kidney basin for collecting urine from female patient
Ureteral catheters, desired size
Set of urethral sounds
Urethral catheters, desired sizes and types (Robinson and Foley)
Wire basket
Biopsy forceps, desired type
Mayo scissors, straight
Mayo-Rochester hemostat, curved
Towel forceps
Irrigating setup, including
 2-5 gallon receptacle secured from ceiling or floor standard
 Sterile water at 92° to 98° F.
 Plastic tubing
 Clamp
 Connector
Brown-Buerger or Braasch cystoscope, desired size, i.e., No. 24 or 28 F for adult (Fig. 466)
Sterile gloves and gowns
Sterile towels and perineal sheet
Antiseptic solution for irrigation

Also

Battery (dry cell) box or transformer
Stools
Plastic apron

For Ureteral Catheterization and Kidney Function Test, add the following:

2 Catheterization telescopes for cystoscope
2 Rubber tips, without hole
2 Rubber tips, with hole
2 Ureteral catheters, i.e., whistle-tip No. 6 or 7 F
2 Stoppers for ureteral catheters
2 Connecting tips for ureteral catheters
4 Test tubes, labelled or marked
2 Syringe, 30 ml.
Opaque media, i.e., phenolsulfonphthalein and sodium carbonate, or indigo carmine
Sensitivity testing setup, i.e., Neo-Synephrine 0.25 ml. (0.5 mg.), 2 ml. syringe and hypodermic needle

For Retrograde Pyelography, add the following:

1 Ureteral catheterization setup
2 Glass burets with rubber tubes
2 Adapter tips for ureteral catheters or 2 syringes, 30 ml., with adapters
50 ml. of Skiodan (10 or 20 per cent) or Diodrast (30 per cent) solution

Considerations.—This operation is seldom done.[2, 12]

Purpose.—To relieve persistent pain that results from a dragging sensation in the redundant scrotum due to pressure of the enlarged veins.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open surgery on the scrotum.

Operative Procedure.—The types and location of incisions are shown in Fig. 465.

Steps	*Items*
1. An incision is made in the lower inguinal region or in the upper portion of the scrotum. The spermatic cord is identified. The arteries and varicosed veins are dissected free from the vas deferens	1. Scalpel, tissue forceps, Kelly hemostats, chromic gut No. 5-0 or silk No. 4-0, suture scissors, small retractors, moist gauze compresses, Allis forceps
2 The excess vessels are clamped and doubly ligated at the points to be sectioned. The portion of the veins between the ligatures and hemostats are removed.	2. Crile or Mayo hemostats, silk or chromic gut No. 0 or 2-0, scissors
3 *To provide support to the testicle,* the distal ends of the resected veins are approximated and secured to the external oblique fascia at a point above the external inguinal ring. The proximal vascular stumps are allowed to retract into the inguinal canal. The wound is closed with or without drainage.	3. *Needle holder and curved Murphy* needle for threading ends of ligatures, moist gauze sponges, scissors; sutures as for scrotal wound closure, Penrose tubing if desired

CYSTOSCOPY AND TRANSURETHRAL SURGERY

Cystoscopy and Tests

Definition of Terms.—A simple cystoscopy includes a visual inspection of the interior of the urethra, the bladder, the ureteral orifices, and the bladder neck by introduction of instruments.

A complete cystoscopy includes visual inspection of the urethra and bladder, removal of a specimen from the kidneys by means of ureteral catheters, and retrograde injection of radiopaque fluid followed by x-ray studies.

Purpose.—To aid the physician in diagnosing abnormalities and lesions of the genitourinary tract.[34]

Setup.—When several cystoscopies and tests are to be done in succession, the instruments and other items should be arranged on a sterile instrument table of the proper height. The sterile equipment needed for each procedure is arranged on a portable stand which is placed near the operator. The remaining pieces of equipment on the sterile table are not contaminated. Sterile transfer forceps are used to take instruments from the stock table during an

examination. The number and kind of items to be prepared will depend upon the number and type of examinations to be done within a six-hour period.

Equipment for Skin Preparation.—

Mild soap and water, or detergent
Sterile water in a pitcher
Cotton swabs
Gauze sponges

Equipment for Examination and Tests.—

Urethral syringe, blunt nose } for topical anesthetic
Pontocaine solution, 2 per cent } for topical anesthetic
Metal pan (12 inches wide, 18 or 20 inches long, and 6 inches deep) containing cold sterile distilled water
Bulb syringe, 1 ounce, with blunt nose for male patient, tapered end for female patient
Gauze compresses, 4 by 4 inches
Cotton balls
Cotton-tipped applicators
Safety pins
Lubricating jelly
Asepto syringe, 30 ml.
Test tubes or bottles labelled right and left for collecting urine specimen from kidneys
Test tube holder
Glass pencil and marker
Round metal basin containing sterile distilled water
Kidney basin for collecting urine from female patient
Ureteral catheters, desired size
Set of urethral sounds
Urethral catheters, desired sizes and types (Robinson and Foley)
Wire basket
Biopsy forceps, desired type
Mayo scissors, straight
Mayo-Rochester hemostat, curved
Towel forceps
Irrigating setup, including
 2-5 gallon receptacle secured from ceiling or floor standard
 Sterile water at 92° to 98° F.
 Plastic tubing
 Clamp
 Connector
Brown-Buerger or Braasch cystoscope, desired size, i.e., No. 24 or 28 F for adult (Fig. 466)
Sterile gloves and gowns
Sterile towels and perineal sheet
Antiseptic solution for irrigation

Also

Battery (dry cell) box or transformer
Stools
Plastic apron

For Ureteral Catheterization and Kidney Function Test, add the following:

2 Catheterization telescopes for cystoscope
2 Rubber tips, without hole
2 Rubber tips, with hole
2 Ureteral catheters, i.e., whistle-tip No. 6 or 7 F
2 Stoppers for ureteral catheters
2 Connecting tips for ureteral catheters
4 Test tubes, labelled or marked
2 Syringe, 30 ml.
Opaque media, i.e., phenolsulfonphthalein and sodium carbonate, or indigo carmine
Sensitivity testing setup, i.e., Neo-Synephrine 0.25 ml. (0.5 mg.), 2 ml. syringe and hypodermic needle

For Retrograde Pyelography, add the following:

1 Ureteral catheterization setup
2 Glass burets with rubber tubes
2 Adapter tips for ureteral catheters or 2 syringes, 30 ml., with adapters
50 ml. of Skiodan (10 or 20 per cent) or Diodrast (30 per cent) solution

For Cystography or Cystourethrography, add the following:

Opaque media, i.e., 250 ml. of Skiodan solution
2 Burets
1 Graduated flask, tubing, and connector if cystoscope not in use

Care and Sterilization of Instruments.—Before the written procedures are compiled, the nurses should consult the latest information published by reliable manufacturers. The *methods carried out to disinfect or sterilize* catheters, filiforms, followers (bougies), and cystoscopes should be re-evaluated at periodic intervals, since improved methods are continually being established (Chapters 2 and 8).

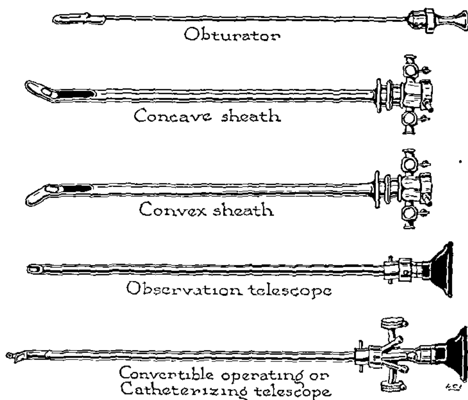


Fig. 466—Brown-Buerger cystoscope. (From Barnes, R. W., and Hadley, H. L.: Urological Practice, St. Louis, 1954, The C. V. Mosby Co.)

Positioning of the Patient, Skin Preparation, and Draping Procedure

The nurse should give the patient the reassurance that he needs at this time. Since it is a diagnostic procedure, the patient is worried about the outcome. Cystoscopic examination in the presence of certain lesions can be painful. General anesthesia in adults and in children is often necessary.[3, 12]

The patient is placed on the cystoscopic table in a lithotomy position (Chapters 4 and 15). The external urethral meatus is cleansed as for catheterization (Chapter 3), and the patient is draped with a fenestrated sheet (Chapters 4 and 15.)

Operations

Cystoscopy

Procedure.—Examination of the bladder, ureters, and kidney functioning includes the following:

1. A local anesthetic is introduced unless the patient is given a general anesthetic. In the male patient, the anesthetic is instilled with a blunt-tip syringe pressed against the meatus. A soft clamp is applied to the end of the glans penis near the meatus. An applicator saturated with the anesthetic is inserted into the meatus. In the female patient, the anesthetic is introduced into the bladder through a urethral catheter.

2. The nurse transfers the sterile instruments to the portable stand. The bladder may be examined without retrograde kidney study or as a first step in a more extensive examination. The sterile cystoscopic cord is placed over the patient's leg. The position of the sterile irrigation receptacle containing the sterile water is adjusted so that it is near the table at a level of four or six inches above the patient. The light cord is connected to the transformer and the free end of the irrigating tubing is connected to the stopcock on the side of the cystoscopic sheath. The electric current is turned on so that the lamp in the cystoscope produces a light that is bright enough to obliterate the filament.

3. The cystoscope is inserted, first the obturator, then the lubricated sheath. The obturator is removed and the telescope is inserted to examine the bladder. The specimen of urine is collected for laboratory examination.

4. When a lesion is present, the upper urinary tract is examined, the observation telescope is removed, and the catheterizing telescope inserted. The ureters are catheterized, and a urine specimen from each kidney is collected. Usually the ureteral catheter which is inserted into the left side is bevelled, and the one which is inserted into the right ureter is straight.

5. Kidney function studies are carried out. The time when the dye appears from the catheters is noted. After completion of the kidney function studies, x-ray pictures are taken. The kidneys are filled with an opaque medium (retrograde pyelography) and x-ray pictures are taken.

6. When the opaque media cannot be injected into the kidney through the ureteral catheter, an intravenous pyelogram is done. In such cases x-ray pictures are taken at 5-, 10-, and 20-minute intervals after the medium has been injected.

7. The ureteral catheters are removed; the operative area is dried. The patient is transferred to his bed or a stretcher and taken to his room or to a rest room.

Transurethral Prostatic Resection

Definition.—Removal of the prostate gland by means of electric cautery loop introduced through the urethra into the bladder.

Purpose.—To relieve a bladder neck obstruction.[12]

Setup, Position, Skin Preparation, an Draping Procedure.—The sterile setup includes the following items.

Perineal preparation setup, or for cystoscopy
Vasectomy setup, if desired
Lubricating jelly
1 Set urethral sounds
1 Scalpel with fine blade
1 Tissue forceps without teeth
1 Mayo-Pean hemostat, curved
4 Towel forceps
1 Asepto syringe, 2 ounces
1 Ellik bladder evacuator
1 Syringe, 30 ml., with adapter
1 Toomey syringe, optional
1 Irrigation setup (as for cystoscopy) with tubing to fit resectoscope
8 Gauze compresses, 4 by 4 inches
1 Wire basket
1 Urethral catheter No. 16, 20, or 22 F with 5 or 30 ml. bag
2 Catheter stoppers
2 Alligator forceps, desired type
1 Resectoscope (Fig. 467)
3 Endotherm cords, and ball and loop
3 Cutting electrodes
2 Oblique telescopes
1 Retrograde telescope
1 Right-angle telescope
2 Extra lamps for telescopes
2 Specimen bottles
1 Pan containing disinfectant
1 Round basin containing sterile distilled water
Antiseptic solution for irrigating bladder
Gowns and gloves
Surgical towels
Fenestrated perineal sheet
Draping sheets for tables

Other Items

Battery box or transformer
Electrosurgical unit with flat plate inactive electrode, connecting cord, and post switch
Plastic apron for operator
Stools for operators
Drain pan and tray attached to operating table

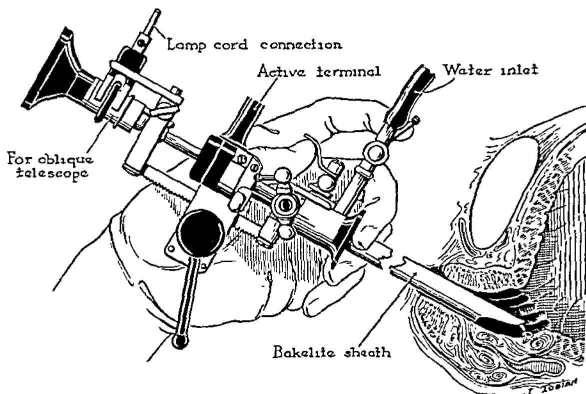


Fig 467.—Endoscopic prostatectomy with Stern-McCarthy electrotome (resectoscope) (From Barnes, R. W., and Hadley, H L. Urological Practice, St Louis, 1954, The C. V. Mosby Co)

The patient is placed on the operating table in a supine position and is anesthetized. In some cases a low spinal anesthetic is given. If a vasectomy is to be done, the inguinal region on either side is cleansed and the patient draped with a fenestrated bilateral vein sheet (Chapter 4).

After completion of the vasectomy, the patient is placed in a lithotomy position. The inactive electrode from the electrosurgical unit is placed beneath and against the patient's buttocks. Safety measures must be carried out to protect the patient from electric burns (Chapter 4).

The working parts of the resectoscope are assembled and lamps tested before the operation begins.

Blood pressor substances, properly matched blood, and transfusion and intravenous sets must be available for immediate use.

Operative Procedure.—

1. The free end of the sterile tubing, attached to the irrigating receptacle, is placed over and around the patient's draped thigh; the lamp cord from the battery box and the electric cords from the electrosurgical unit (coagulation and cutting currents) are draped over the operative field and secured to the perineal sheet with forceps. The foot switch from the electrosurgical unit is placed in easy reach of the operator; stools are arranged near the operative field and adjusted in height to suit the operators.

2. The urethra may be dilated with urethral sounds that have been lubricated. A meatotomy may be necessary, using a scalpel, hemostat, and scissors. A simple cystoscopy may be done, using a Brown-Buerger or McCarthy scope.

3. The current from the battery box is turned on; the light from the resectoscope is adjusted. The water supply is connected to the resectoscope.

4. The sheath of the resectoscope is lubricated and introduced into the bladder. The operating element is inserted into the sheath and all other parts connected to the electrotome.

5. The prostatic gland and other obstructing tissue or lesion are removed. The bleeding vessels are fulgurated. The operating element is removed, and the fragments of tissue are evacuated, using alligator forceps and Ellik evacuators filled with an isotonic or hypotonic solution.

6. The bladder and prostatic fossa are inspected, and bleeding is controlled by fulguration. In some cases a 2 per cent glycine, a 3 per cent mannitol solution, or another isotonic sugar solution may be used. Such a solution helps to reduce hemoglobinemia, which results from the entrance of a hypotonic solution into the open venous sinuses during surgery.

7. A Foley catheter is introduced into the bladder. The Foley bag is inflated with a small amount of irrigating fluid introduced through the catheter. The exposed end of the catheter is closed off with a stopper.

8. The patient is transferred from the operating table to his bed or a recovery room stretcher He is kept in a modified supine position so that venous stasis in the lower extremities may be prevented.

Removal of Prostatic Calculi.—As described for transurethral prostatic resection. Large stones are removed with forceps.

Manipulation of Ureteral Stones

Definition.—Crushing and removal of ureteral calculi by means of a cystoscopy.

Considerations.—The calculi, when less than 6 ml. in diameter, may be removed by the transurethral approach. The presence of calculi predicates chronic infection and may lead to squamous cell carcinoma of the bladder. The choice of operation depends upon the type of instruments available, the surgeon's preference, the size and number of stones present, and the patient's physical condition.[2, 12]

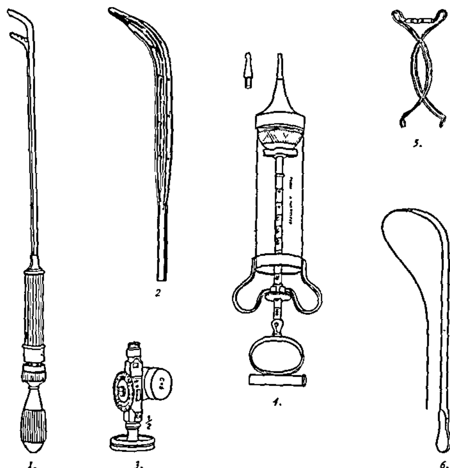


Fig 468 —Genitourinary instruments *1*, Bigelow lithotrite, *2*, Kollmann dilator; *3*, Kollmann handle with adjusting dial, *4*, Janet-Frank bladder syringe; *5*, Stockman or Zipser penis clamp. *6*, Le Fort urethral sound complete with filiform guide, set sizes 8 to 34 F

Setup, Position, Skin Preparation, and Draping Procedure.—The setup includes the following:

Complete cystoscopy setup
Rongeurs (Ryall or Young) for visual method
Keyes-Bigelow or Thomson lithotrite for blind method
Lowsley, McCarthy or Johnson stone forceps
Evacuator set
McCarthy panendoscope sheath

The patient is prepared and draped with sheets as described for a transurethral prostatic resection.

Operative Procedure.—

1. The bladder is distended with sterile water, a cystoscopic examination is done, and the sizes of the stones are determined, if possible.

2. The calculus is crushed with a suitable instrument placed in the manipulating guide in the scope. The fragments are removed with a panendoscope barrel, evacuators, and forceps. An indwelling urethral catheter is introduced into the bladder, especially when there has been profuse bleeding. The bladder is irrigated to help dissolve the remaining encrustations.

Ureteral Meatotomy

Definition.—Removal of stenotic fibrous bands of the ureteral meatus.

Purposes.—To relieve a hydroureter above the stricture or prior to removal of a ureteral calculus, or to provide adequate drainage through a ureterocele.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for complete cystoscopy, plus the following:

Braasch cystoscope No. 24 or 28 F, or
Panendoscope, if desired
2 Ureteral catheters, desired size

Electrosurgical unit and attachments,
or
Special cystoscopic shears

Operative Procedure.—Through a transurethral approach a special type of electrode or scissors is introduced into the ureterovesical orifice. The ureteral meatus is divided and the ureter dilated.

Urethral Dilation and Urethrotomy

Definition.—Gradual dilation and removal of the stricture in the urethra.

Purposes.—To allow better drainage of the kidney and to relieve pain.

Setup, Position, Skin Preparation, and Draping Procedure.—Cystoscopy setup, plus the following:

Phillips or Le Fort bougies and followers, various sizes ranging from No. 6 to 26 F (Fig. 469)
Metal sounds, various sizes
Electrosurgical unit
Otis or Maisonneuve urethrotome
Antiseptic solution for bladder irrigation

Asepto syringe
Ellik evacuator
Indwelling catheter
Gloves and gowns
Fenestrated sheet
Lubricating jelly
Gauze compresses, 4 by 4 inches

Operative Procedure.—

For Gradual Dilation.—The urethra is lubricated and anesthetic ointment applied.

A filiform is passed through the urethra into the bladder; Le Fort sounds or Phillips bougies attached to filiforms are passed into the bladder (Fig. 469). Both are removed, and an indweelling catheter is inserted into the bladder. When a bougie No. 18 or 20 F can be passed, urethral sounds rather than bougies may be used.[2, 12]

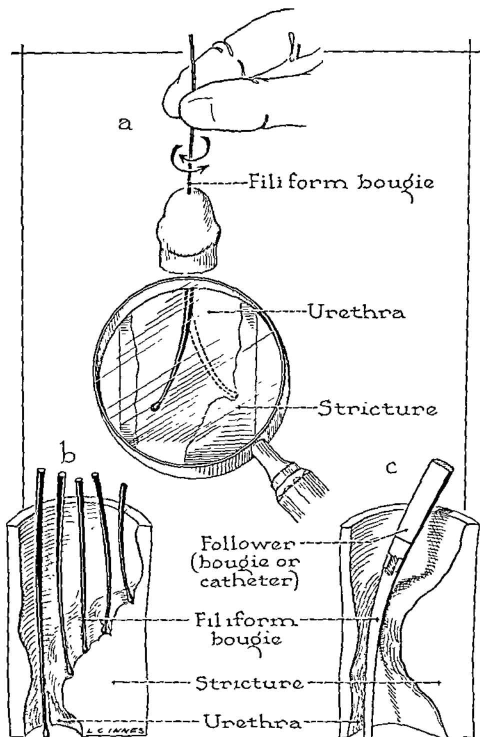


Fig. 469—A method of using coude-tip bougie for passing a stricture *a*, Bougie is withdrawn 1 to 2 cm each time an obstruction is met, is rotated, then passed inward again. *b*, Method of using multiple bougies to pass through a urethral stricture Pocket is filled with bougie tips; this [illegible] he opening through the stricture. *c*, Phillips filiform and [illegible] onto the end of the filiform Filiform passed through the [illegible] (From Barnes, R W., and Hadley, H L: Urological Prac- [illegible] Co)

For Internal Urethrotomy.—The filiform is passed into the bladder; the Riba urethrotome is connected and inserted. The fulgurating electrode is attached to the urethrotome and the stricture removed. An indwelling catheter is inserted into the bladder via the urethra.

REFERENCES

1. Campbell, M. F.: Urology, Philadelphia, 1954, W. B. Saunders Co.
2. Dodson, A. I.: Urological Surgery, ed. 3, St. Louis, 1956, The C. V. Mosby Co.
3. Lowsley, O. S., and Kirwin, J.: Clinical Urology, ed. 3, Baltimore, 1956, Williams & Wilkins Co.
4. Zoethout, W D, and Tuttle, W. W.: Textbook of Physiology, St. Louis, 1955, The C. V. Mosby Co.
5. Flock, R. H., and Culp, D.: Surgical Urology, Chicago, 1954, Year Book Publishers, Inc.
6. Dodson, A I, and Gilbert, R. D.: Synopsis of Genitourinary Diseases, ed. 6, St. Louis, 1957, The C V. Mosby Co.
7. Lowsley, O, and Kirwin, J.: Urology for Nurses, Philadelphia, 1948, J. B. Lippincott Co.
8. Rolnick, H. C: Practice of Urology, Philadelphia, 1949, J. B. Lippincott Co.
9. Roen, P. R., and Stern, C.: Atlas of Genitourinary Surgery, New York, 1951, Appleton-Century-Crofts, Inc.
10. Smith, H. W: Principles of Renal Physiology, New York, 1956, Oxford University Press.
11. Cordonnier, J J.: Urology for General Practice, St. Louis, 1956, The C. V. Mosby Co
12. Barnes, R. W, and Hadley, H L.: Urological Practice, St. Louis, 1954, The C. V. Mosby Co.
13. Chute, R.: Preoperative and Postoperative Care of Aged Patients Undergoing Urologic Surgery, [illegible]
14. [illegible] & Wilkins Co.
15. [illegible] The C. V. Mosby Co.
16. [illegible] ry Injuries, S. Clin. North America, 10:1373, 1956.
17. Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co.
18. Ockerblad, N. F.: Urology, ed 2, Chicago, 1947, Year Book Publishers, Inc.
19. Heckel, N. J: Kidney Stones, Am J. Nursing 55:194, 1955.
20. Spence, H M, and Littlepage, S: Genitourinary Injuries and Nursing Care, Am. J. Nursing 55:970, 1955.
21. Campbell, M F.: Clinical Pediatric Urology, Philadelphia, 1951, W. B. Saunders Co.
22. Smith, R D.: Psychologic Aspects of Urology in Women, GP 8:57, Nov., 1953.
23. [illegible] The Management of Cutaneous Ureterostomies, Am. [illegible]
24. [illegible] ology of Ureterointestinal Anastomosis Ureteral Reflex, [illegible]
25. Reische, C: Preoperative and Postoperative Technic in Management of Ureterointestinal Anastomosis, J. Urol 65:500, 1951.
26. Rubin, I, and Novak, E: Integrated Gynecology (Principles and Practice), New York, 1956, McGraw-Hill Book Co, Inc.
27. Scott, W., Hopkins, W. J., and Perry, H B.: Surgery of the Adrenal Gland, Springfield, Ill, 1954, Charles C Thomas, Publisher
28. Smith, F. M, Smith, C. H, and Young, J. H Bilateral Adrenalectomy for Carcinoma, Connecticut M J. 66:580, 1952.
29. Wilkins, A H: Urethritis in Women, GP 7:51, 1953
30. Davis, D M.: Meatotomy With Fine Wire Electrodes, J Urol 65:695, 1951.
31. Barnes, R. W., and Purdey, G Prostatic Tumors, Surgical Treatment and Nursing Care, Am J Nursing 56:605, 1956.
32. Wesson, M. B Prostatectomy Rationale, Am J. Surg 82:714, 1951.
33. Beneventi, F A.: [illegible] Enlargement of Prostate Gland, Springfield, [illegible]
34. Wesson, M B: [illegible] 1950, Lea & Febiger.

*Films**

Higgins, C C Transplantation of Ureters Into Rectosigmoid and Cystectomy.
Young, H H. Perineal Prostatectomy.

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*Available from the Surgical Film Library, Surgical Division Products, American Cyanamid Co, Danbury, Conn.

CHAPTER 17

ORTHOPEDIC SURGERY

Orthopedic surgery is done to prevent or repair traumatic injuries and congenital deformities, or to treat diseases of the bone, joints, ligaments, cartilages, tendons, muscles, and nerves associated with the skeletal framework of the body. To care for each patient, the physician needs capable, reliable assistants who have a good understanding of the surgical plan of treatment, as well as adequate, safe operating room facilities and equipment in perfect condition and properly prepared.

ANATOMY

Knowledge of the normal anatomic structures involved in an orthopedic operation helps the worker to become an efficient member of the operating team. The worker should review the anatomic structures in the standard textbooks The anatomy will be summarized briefly.[1-9]

The Hip and Femur

The hip joint, a ball and socket joint, is formed by the acetabular portion of the innominate (hip) bone and the upper end of the femur. The hip joint is surrounded by a capsule, ligaments, and muscles (Figs. 470 and 471).

The acetabulum is a deep round cavity that receives the head of the femur. The upper end of the femur consists of the femoral head and neck, the upper portion of the shaft, and the greater and lesser trochanters.

The greater trochanter is a broad process of cancellous bone, which protrudes from the outer upper portion of the shaft and projects upward from the junction of the superior border of the neck with the outer surface of the shaft. It serves as a point of insertion for the abductor and short rotators of the hip. (Fig. 471.)

The lesser trochanter is a conical process, which projects from the posterior and inferior portion of the base of the neck of the femur at its junction with the shaft and serves as a point of insertion for the iliopsoas muscle (Fig. 470). The lower end of the femur terminates in the two condyles. In front, the condyles are separated from one another by a smooth depression called the intercondylar groove, forming an articulating surface for the patella. Behind, they project slightly, and the space between them forms a deep fossa, the intercondyloid fossa. (Fig. 472.)

The upper, or condylar, end of the tibia presents an articular surface corresponding with those of the femoral condyles. The articular surface of the two tibial condyles forms two facets, which are deepened by the semilunar cartilages into fossae for the femoral condyles (Fig. 472).[7,8]

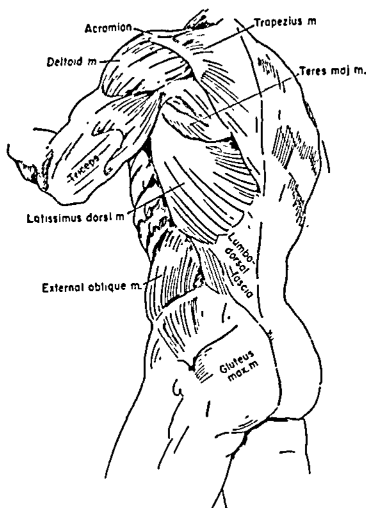


Fig 470—Superficial muscles of the trunk, shoulder, and hip Posterior view (From Howorth, M B A Textbook of Orthopedics, Philadelphia, 1952, W. B. Saunders Co)

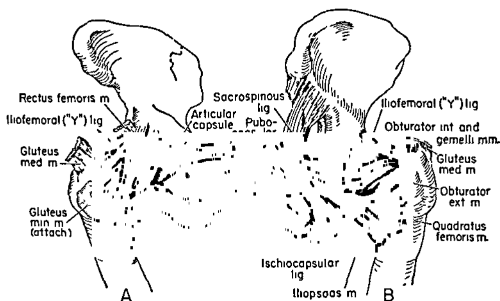


Fig 471—Ligaments of the hip Anterior and posterior views (From Howorth, M. B.: A Textbook of Orthopedics, Philadelphia, 1952, W. B Saunders Co)

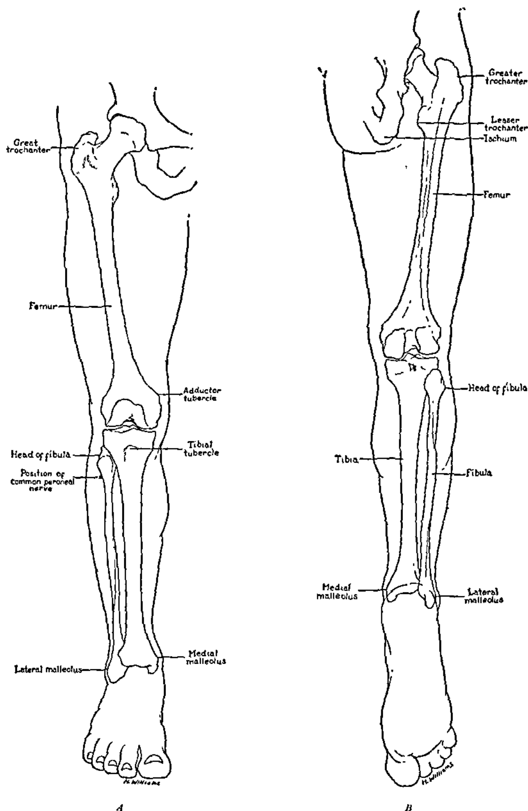


Fig 472.—Right lower extremity *A*, Anterior view, bones outlined. *B*, Posterior view; bones outlined. (From Francis, C C Introduction to Human Anatomy, St Louis, 1954, The C. V. Mosby Co)

The Knee and Knee Joint

The patella, so-called kneecap, is situated in front of the knee joint, in the anterior intercondylar groove of the lower end of the femur.[3, 10] It is developed within the quadriceps tendon and is composed mainly of cancellous bone. The anterior and inferior surfaces of the patella are united with the patellar tendon. The posterior surface of the patella is intra-articular and is related closely to the fat pad of the knee. The knee joint is formed by three articulations in one. They are two condyle joints, one between each condyle of the femur and the corresponding meniscus and condyle of the tibia, and a third articulation between the patella and femur. (Fig. 473*A*.)

The bones of the knee joint are connected by sets of ligaments classified as extra-articular and intra-articular structures (Fig. 473*B*). The extra-articular attachments include the capsule, quadriceps muscle, two collateral ligaments, and the oblique popliteal ligament. The intra-articular ligaments include the cruciate ligaments and the attachments of the menisci (the so-called semilunar cartilages).

The capsule of the knee joint is attached above to the lateral surfaces of the condyles and to the posterior surface of the shaft of the femur, and below it is attached to the condyles of the tibia and to the upper end of the fibula. The capsule is reinforced, in front by the patellar and quadriceps tendon, on the sides by the internal and external lateral ligaments (tibial collateral), and posteriorly by the popliteal and gastrocnemius muscles.

The cruciate ligaments, consisting of two fibrous bands, extend from the intercondylar fossa of the femur to attachments in front of and behind the intercondylar surface of the tibia (Fig. 473*B*).

The semilunar cartilages, known as the menisci, are interposed between the condyles of the femur and those of the tibia. Each cartilage is attached to the joint capsule. The ends of the cartilages are attached to the tibia in the mid-area of its upper articular table.[10]

Synovial membrane lines the capsule of the joint and covers the infrapatellar fat pad and parts of the crucial ligaments and portions of the bone.

The portion of the knee joint cavity that extends upward in front of the femur is called the suprapatellar or quadriceps bursa. The infrapatellar bursa lies between the patellar tendon and the upper margin of the tibia (Fig. 473*B*)

The Ankle and Foot

The ankle joint, a hinge joint, is formed by the lower end of the tibia and its malleolus, the malleolus of the fibula, and the inferior transverse ligaments (Fig. 472). These structures form a mortise for the reception of the upper surface of the talus and its facets.

The bones are connected by ligaments, which spread out from the malleoli to be attached to the os calcis, astragalus, and scaphoid bones. The joint is surrounded by a thin capsule. (Fig. 474.)

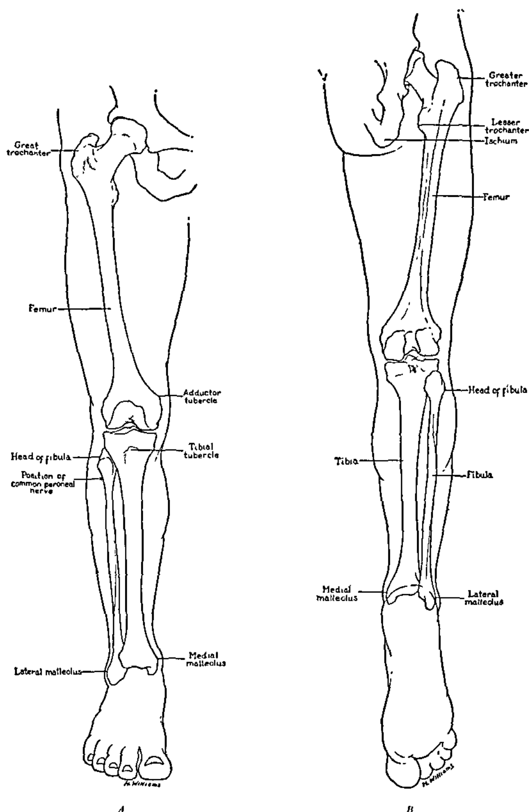


Fig 472.—Right lower extremity A, Anterior view; bones outlined B, Posterior view; bones outlined (From Francis, C C Introduction to Human Anatomy, St Louis, 1954, The C. V. Mosby Co)

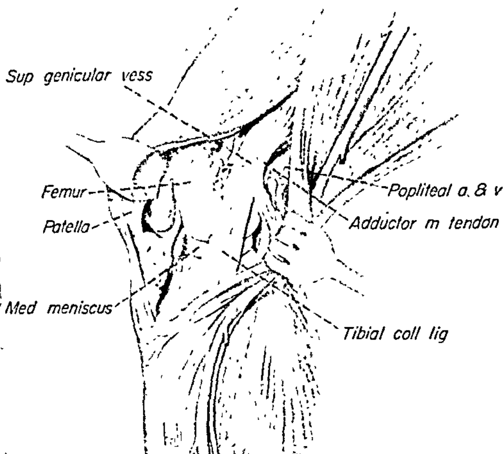


Fig. 473B.—Deeper anatomy of the medial aspect of knee. Note arterial anastomosis beneath proximal attachment of tibial collateral ligament. (From dePalma, A F.: Diseases of the Knee, Philadelphia, 1951, J. B Lippincott Co)

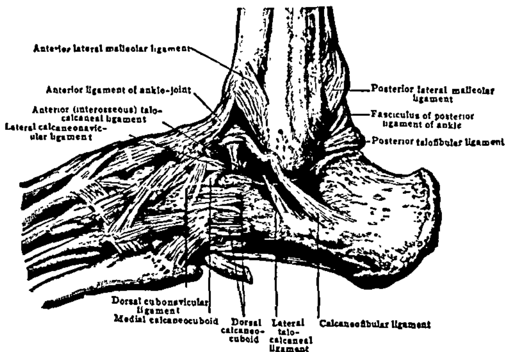


Fig. 474.—Drawing of the ankle joint seen from the ...

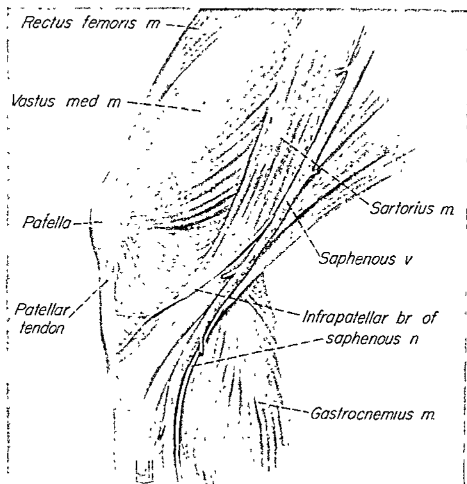


Fig 473*A* —Anatomic relationships of the superficial structures on medial aspect of knee. (From dePalma, A F: Diseases of the Knee, Philadelphia, 1954, J. B Lippincott Co)

The astragalus, known as the talus, consists of a body, neck, and head. It is an irregular bone which fits into a mortise formed by the malleoli. It articulates with the calcaneus and navicular bones. (Fig. 472.)

The bony framework of the foot comprises seven tarsal bones, five metatarsals, and fourteen phalanges.

The os calcis, a large bone, forms the heel and gives support to the astragalus. The cuboid bone articulates posteriorly with the os calcis and anteriorly with the fourth and fifth metatarsals and the external cuneiform bones.

The scaphoid bone articulates with the cuneiform bones, which lie side by side in front of the scaphoid. The metatarsal bones articulate proximally with the tarsal bones and distally with the bases of the first phalanges of the corresponding toes. The phalanges of the toes consist of two for the great toe and three for each of the other toes.

The Shoulder and Upper Extremity

The clavicle, which is a long doubly curved bone and attached to the spinal vertebras by muscles, serves as a prop for the shoulder and holds it

The scapula (shoulder blade) is a flat triangular bone which forms the posterior part of the shoulder girdle. Lying over the upper chest, its head, or outer portion, provides a socket for the humerus, the glenoid cavity; and its acromion process articulates with the clavicle (Fig. 476). The scapula is attached to the trunk by muscles.

The sternoclavicular joint is the articulation structure between the outer end of the clavicle and a flattened articular facet situated on the inner border of the acromion (Figs. 476 and 477). The convex head of the humerus articulates with the shallow glenoid cavity of the scapula.

The shoulder joint, a ball-and-socket joint, is formed by the head of the humerus and the glenoid cavity.[9] This joint is surrounded by a loose capsular

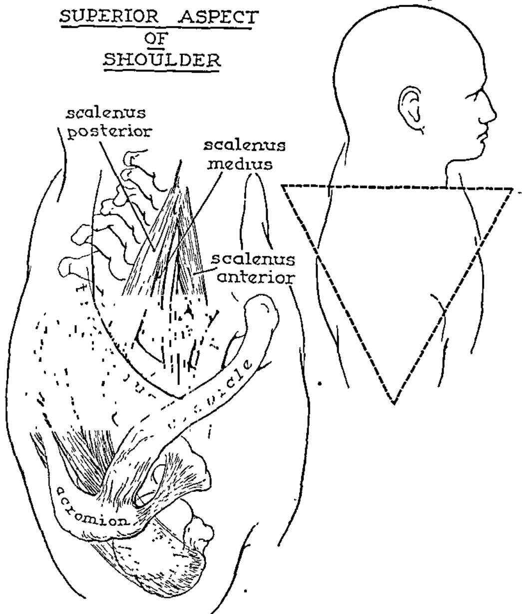


Fig 476.—Anatomy of the superior aspect of the shoulder (From Bateman, J E.: The Shoulder and Environs, St. Louis, 1955, The C V Mosby Co)

away from the chest wall.[9, 11] The clavicle rests almost horizontally at the upper and anterior part of the thorax above the first rib. It articulates medially with the manubrium of the sternum and laterally with the acromion of the scapula (Fig. 475).

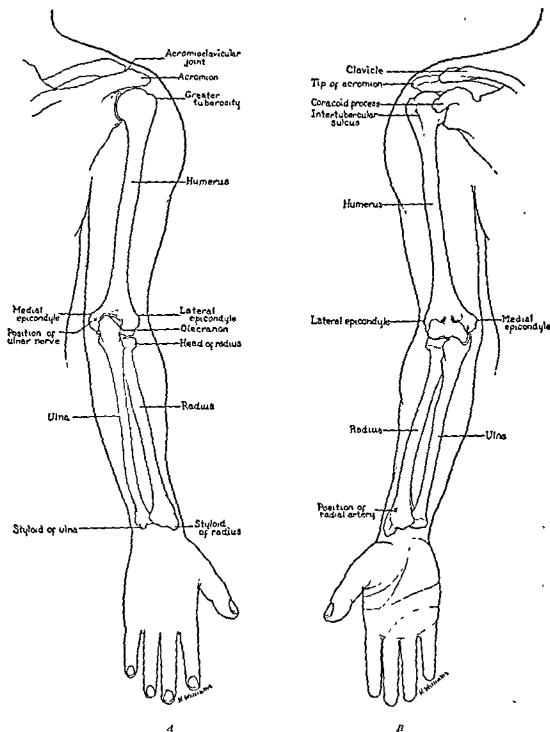


Fig 475.—Right upper extremity *A*, Anterior view, bones outlined *B*, Posterior view, bones outlined. From Francis, C C· Introduction to Human Anatomy, St. Louis, 1954, The C. V. Mosby Co)

tomic neck marks the attachment to the capsule of the shoulder joint. The greater tuberosity is situated at the lateral side of the head. Its upper surface has three impressions; these give insertion to the supraspinatus, the infraspinatus, and the teres minor muscles.

The lesser tuberosity is situated in front of the neck and has an impression for the insertion of the tendon of the subscapularis muscle. The tuberosities are separated from each other by a deep groove (the bicipital groove), in which lies the tendon of the biceps brachii.[8] The tendon of the latissimus dorsi inserts at its posterior margin. (Fig. 470.)

The body of the shaft has three borders and three surfaces. The anterior border serves above for the insertion of the tendon of the pectoralis major and below for the tendon of the brachialis muscle. The lateral border serves for the insertion of the teres minor, and the medial border serves for the attachment of the tendon of the teres major.

The lower portion of the humerus is flattened and ends below in a broad articular surface, which is divided into two parts by a slight ridge. On either side of the ridge are projections, the lateral and medial condyles. On the lateral condyle the rounded articular surface is called the capitellum. It articulates with the head of the radius. On the medial condyle the articular surface is termed the trochlea, and it articulates with the ulna.

The ulna is placed at the medial side of the radius. The upper portion of the ulna presents two curved processes, the olecranon, posteriorly, and the coronoid process, anteriorly; also two cavities, the articular cavities. The curved semilunar notch that connects them articulates with the trochlea. On the outer side is the radial notch, which articulates with the circular border of the radial head (Fig. 475).

The radius rotates around the ulna. At the upper end is the head, which articulates with the capitellum of the humerus and also with the radial notch of the ulna. To the tuberosity below the upper end is attached the tendon of the biceps muscle. The lower end of the radius is divided into two articular surfaces. The distal articular surface articulates with the carpal bones of the wrist, while the other on the medial side articulates with the lower end of the ulna (Fig. 475).

The Wrist and Hand

The skeletal bones of the wrist and hand consist of three distinct parts: (1) the carpus, or wrist bones, (2) the metacarpus, or bones of the palm, and (3) the phalanges, or bones of the digits (Fig. 478).

The carpal bones consist of eight bones arranged in two rows. The proximal row, proceeding from the radial to the ulnar side, includes the navicular, lunate, triquetrum, and pisiform, and the distal row, the greater multangular, lesser multangular, capitate, and hamate bones (Fig. 478).

Each bone, except the pisiform bone, presents six surfaces. Their surfaces consist of rough areas for the attachment of muscles and tendons and smooth articular surfaces for contact with the adjacent bones. The pisiform bone forms

ligament which is strengthened by the coracohumeral ligament. The coracohumeral ligament extends from the coracoid across the top of the joint to the greater tuberosity of the humerus. (Fig. 470.)

The muscles surrounding the shoulder joint are the supraspinatus, the infraspinatus, the teres minor and teres major, and the subscapularis muscles. These muscles steady the shoulder girdle in movements of the entire arm.

The humerus, the longest and largest bone of the upper extremity, is composed of a shaft and two extremities.

The upper extremity has two projections, the greater and lesser tuberosities (Fig. 475).

The head articulates with the glenoid cavity of the scapula. The circumference of its articular surface is constricted and is termed the anatomic neck. The constriction below the tuberosities is called the surgical neck. The ana-

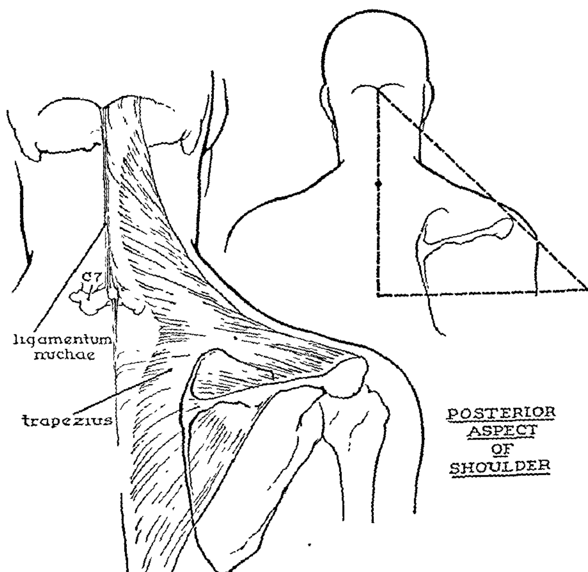


Fig. 477 —Anatomy of the posterior aspect of the shoulder (From Bateman, J. E · The Shoulder and Environs, St Louis, 1955, The C V Mosby Co)

Viewing box
Basin, soap, and water
Medicated skin lotion
Washcloth and towel
Stockinet or cotton shirt of an appropriate shape and size for cast lining
Sheet wadding of an appropriate width for padding the body
Crepe paper bandages of an appropriate width to hold the sheet wadding in place and to present a smooth surface
Piano felt or sponge rubber of an appropriate thickness and size to protect the bony prominences
Unsterile gown and gloves
Cream for operator's hands
Deep pail, lined with a paper bag and filled with water at 95° to 105° F. for soaking plaster bandages
Pan for soaking wooden splints
Yucca boards, plywood or aluminum splints for reinforcing stress points of cast
Plaster-of-Paris bandages of various widths to make cast
Metal measuring tape
Red pencil for marking measurements
Scalpel handle No. 4 and blade No. 22
Resin
Plaster knives, heavy scissors, plaster cutters
Plaster powder to mold an even surface
Cast saw and spreaders for removal of cast
Waste receptacle for refuse, and dampened sponge-rubber door mat to remove dust particles on shoes

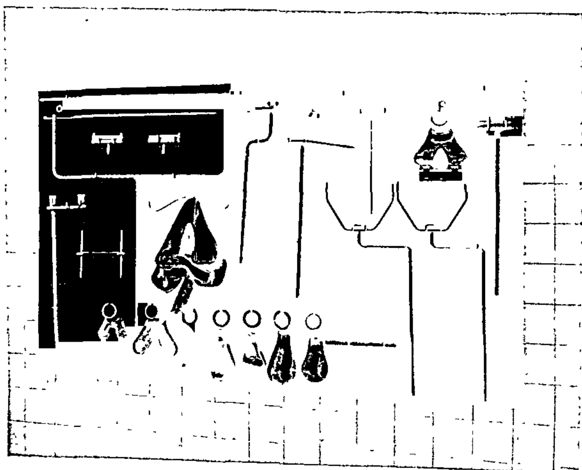


Fig 479 —Board for display of parts to a fracture table, that they may be readily available and may not be misplaced or lost. (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St Louis, 1956, The C. V Mosby Co)

a projection at the front of the wrist on the ulnar side and has a single articular facet.

The metacarpal bones, consisting of five, are situated in the palm. Each bone has a shaft and two extremities. They articulate proximally with the distal row of carpal bones, and distally the head of each metacarpal articulates with its proper phalanx. The heads of the metacarpals form the knuckles. (Fig. 478.)

The phalanges, called finger bones, consist of fourteen bones, two in the thumb and three in each of the fingers. Each phalanx consists of a shaft and two extremities.

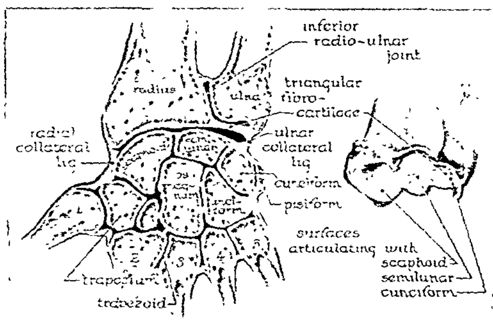


Fig. 478.—Anatomy of the wrist and carpus (From Moseley, H. F.: Textbook of Surgery, St. Louis, 1955, The C. V. Mosby Co)

FACILITIES AND SETUPS FOR ORTHOPEDIC SURGERY

Because bones, joints, and tendons are most susceptible to infection, the unit must be scrupulously clean (Chapter 2). The facilities of a modern operating room have been described in Chapter 1.

It is impossible to mention all the pieces of equipment needed to perform all types of surgery and to be definite in every instance, since surgeons have a few preferences for certain instruments to perform the same type of operation.

Setups listed in this section are suggested as a guide to operating room personnel who are developing standard setups.

Equipment for External Reduction of Fractures

Immobilization of a Fracture.—The setup includes the following:

Body suspension frame
Traction equipment, splints, and brace appliances
Fracture table with suitable attachments (Fig. 479)
X-ray pictures of patient's condition

Setups for Open Reduction and Fixation of a Fractured Lower Extremity

The instruments and textiles must be *suitable to the size and location of* the structures involved.[4, 8, 12-15]

Basic Setup.—The items include the following:

- 2 Scalpel handles, Nos. 4 and 3
- 3 Scalpel blades, Nos, 21, 20, and 10
- 2 Mayo scissors, curved on flat—1, 5½; 1, 6¼ inches
- 1 Mayo scissors, straight, 6½ inches
- 1 Suture and wire scissors
- 1 Mayo-Harrington dissecting scissors, suitable weight and length
- 10 Towel forceps
- 3 Tissue forceps, 2 and 3 teeth, 5½ inches
- 1 Tissue forceps, 4 and 5 teeth, 6 inches
- 1 Dressing forceps, 6 inches
- 2 Hook retractors, single point
- 1 Probe, with eye, 5½ inches
- 1 Grooved director, with tongue tie, 5½ inches
- 8 Foerster sponge forceps, 8 inches
- 2 Maier or Pean forceps, 7 inches, optional
- 1 Crile-Wood needle holder, heavy type, 6 inches
- 2 Volkman or Israel retractors, 4 prongs, blunt points
- 2 Goelet, Roux, or Greene retractors, appropriate size
- 2 Bennett retractors, desired size (Fig. 481)
- 3 Langenbeck or Sauerbruch retractors, 8 inches, flat, blunt-angled blade with lip, 3 sizes available
- 4 Hibbs or Meyerding retractors, appropriate sizes (Fig. 481)
- 2 Richardson or Deaver retractors, optional
- 12 Crile artery forceps, straight, 5½ inches
- 8 Mayo-Pean artery forceps, curved, 6¼ inches
- 2 Ochsner artery forceps, straight, 6¼ inches
- 4 Allis forceps
- 1 Ferguson or Kern bone-holding forceps
- 1 Van Buren sequestrum forceps
- 1 Volkman or Brun bone curette, suitable size
- 1 Lane periosteal elevator, narrow or wide, 6¾ inches
- 1 Farabeuf, Kermisson, or Campbell curved periosteal raspatory, 5¾ inches
- 1 Sayre or Key periosteal elevator and raspatory, 6½ inches
- 2 Luer, Horsley, or Stille-Luer rongeurs—1 curved and 1 straight, 6½, 7 or 10½ inches
- 1 Liston bone-cutting forceps, 7½ inches
- 2 Albee, Meyerding, Crane, or Lambotte osteotomes, suitable widths
- 2 Stille, Alexander, Meyerding, or Abbott chisels, suitable widths
- 1 Hibbs, Crane, or Meyerding mallet, suitable weight and length
- 1 Asepto syringe, 2 ounces

Sutures

For *bones:* Stainless steel No. 3-0, 2-0, or 0, or extra chromic gut No. 2 or 1

For *tendons and ligaments:* Silk or stainless steel Nos. 6-0 to 3-0, and gauges 34 and 28 for tendocalcaneus repair

For *nerves:* Surgical gut or silk Nos. 6-0 to 4-0, stainless steel or tantalum No. 6-0, or cotton No. 3-0

For *tension:* Silk Nos. 2-0 to 3, or nylon Nos. 2-0 to 3

For *fascia and muscle:* Surgical gut, medium chromic gut, No. 3-0, 2-0, or 0, silk Nos. 4-0 to 0, or stainless steel No. 5-0, 4-0, or 3-0

For *skin:* Nylon, or silk Nos. 4-0 to 2-0, or wire No. 6-0

Needles

For *bone fragments and ligaments:* 2 Martin ½-circle cutting-edge, No. 5; or 2 Mayo ½-circle trocar-point No. 2; or Schroeder ⅜-circle taper-point No. 1½ or sutures and swaged-on needles

External Fixation and Traction.—The setup includes the following:

1 Scalpel with blade No. 3
2 Scalpels, handle No. 3 and blade No. 10
3 Towel forceps
2 Tissue forceps, 1 and 2 teeth
3 Sponge-holding forceps
2 Crile hemostats
1 Mayo scissors
2 Ochsner forceps
1 Zimmer, Kirschner, or DePuy bone drill with telescoping guide (Fig. 480)
1 Drill wire guide
4 Kirschner wires, appropriate diameter
2 Kirschner nuts
1 Kirschner wire tractor
1 Wrench for tightening nuts
1 Screw driver for tightening traction apparatus
1 Zimmer or Berbecker wire cutter
2 Corks to cover ends of wire
Wire sutures No. 6-0 and skin needles
Steinmann pins, of an appropriate type, and holder, if desired
Jacobs chuck and key (Fig. 480)
6 Sterile towels
2 Sterile sheets to suit the extremity
Gown pack, glove set, gauze compresses
Local set including syringes, needles, and anesthetic, such as a 1 per cent solution of Novocain
Special traction appliance

Other Items

Germicide
Collodion
Gentian violet
Pulley rope
Plaster-of-Paris cast setup
Traction apparatus
Mayo stand
Small instrument table

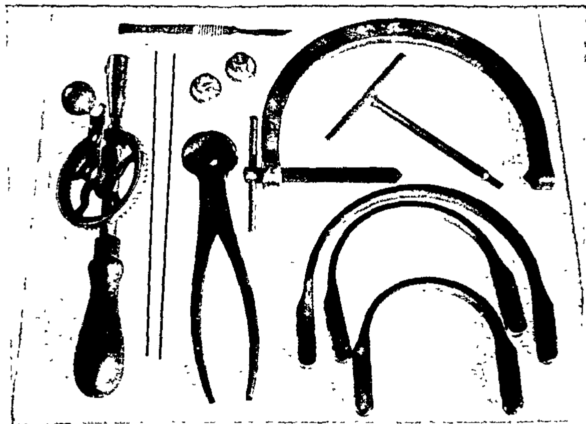


Fig 480—Instruments for skeletal traction (From Speed, J S, and Knight, R. A.: Campbell's Operative Orthopaedics, St Louis, 1956, The C V Mosby Co)

For *fascia:* 2 Mayo ½-circle taper-point No. 4 or 3, and 2 Murphy ½-circle taper-point No. 1 or 2
For *skin:* Keith abdominal, straight, 2¼ inches, or 2 regular surgeon's ⅜-circle cutting-edge No. 10 or 12 (sutures with swaged-on needles may be used rather than eyed needles)

Textiles and Other Supplies

Major operating pack
Radiopaque gauze sponges of various sizes
Gown pack
Glove set
Surgical dressings
1 Piece absorbent cotton, 12 by 12 inches
Gauze bandages of appropriate size
Skin towels, or stockinet of an appropriate size
Orthopedic pack suitable to extremity
Parenteral fluids and infusion set
Bone wax
Fascia lata, if requested

Also

Fracture table with appropriate attachments for extremity (Fig. 479)
Abduction frame which can be heat-sterilized
Sponge-rubber pads, sandbags, or rolls
Infusion standard
Floor lamp
Pneumatic tourniquet
Elastic cotton bandages
Plaster-of-Paris setup, if needed

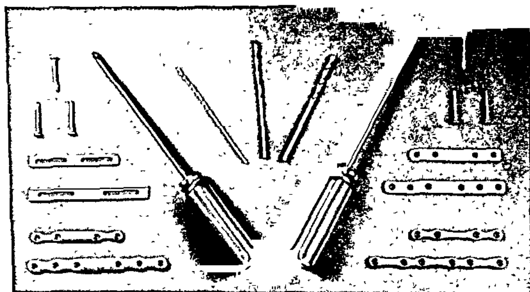


Fig 482—Internal fixation of bone fragments. Top, Screws, drill points, and drivers Left side below, 2 Eggers splints, 2 modified Sherman bone plates. Right side below, 2 Venable bone plates and 2 Sherman bone plates (Courtesy Austenal, Inc, Surgical Division, New York, N. Y.)

Bone Plating.—The setup includes basic open reduction setup, plus the following:

2 Lane bone-holding forceps for long bones (Fig. 481)
4 Lowman or Lowman-Lambotte bone-holding forceps (Fig. 481)
1 Putti or Stille rasp
1 Lane or Abbott bone guard and retractor, appropriate size
1 Meyerding, Murphy, or Scudder bone skid
2 Bennett bone elevators and retractors, appropriate size (Fig. 481)
1 Metal ruler
1 Lewin or Joplin bone forceps (Fig. 481)

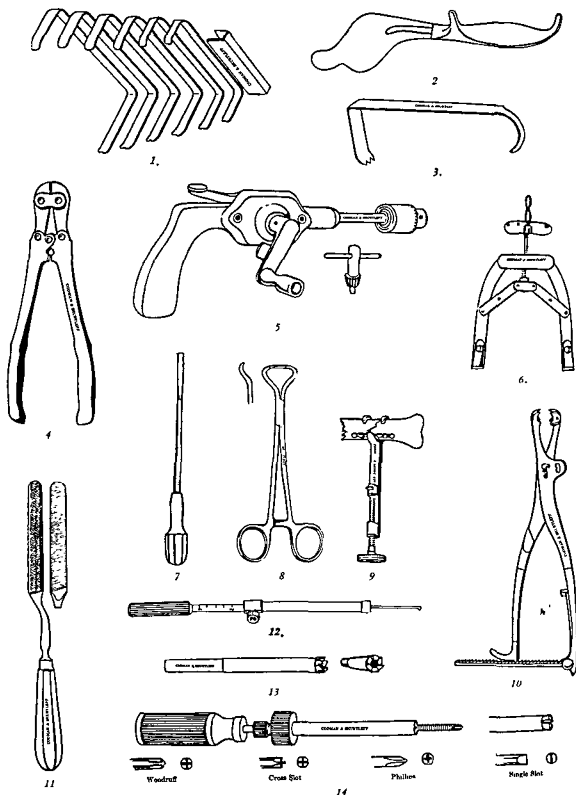


Fig. 481 —Instruments for open reduction of long bones: *1,* Sofield retractors (set of six); *2,* Bennett tibia retractor, *3,* Hibbs retractor; *4,* multiple-action bone pin cutter; *5,* Smedberg drill, shaft sizes 1½ and 4 inches cannulated, *6,* Kirschner wire tractor; *7,* Lane screwdriver;

1 Bone awl
1 Stille-Sherman or Zimmer-Kirschner drill
2 Chuck keys
1 Drill gauge (Fig. 481)
1 Drill guide for bone plates or grafts
1 Lane screw-holding forceps
2 Lane plate-bending forceps
1 Electric motor saw and drill attachments with drill points
1 Electrocoagulation machine and attachments, optional
1 Screw starter
2 Screwdrivers for Sherman, Wood, Woodruff, or cross-lot slot head, or Phillips screws
Plates, 18-8 SMO stainless steel or vitallium, straight or curved, of proper width and size (Fig. 482), i.e.—
For *small bones,* plates with 2, 3, and 4 openings
For *large bones,* plates with 4, 6, or 8 openings or Venable, Sherman, Eggers contact splint, or Acme slotted type
Screws, Venable type, self-tapering, with 20 to 32 threads to the inch, or Phillips, or Sherman type, various lengths and diameter (Fig. 482)
Metal container for holding plates, screws, and drills
Drill points, suitable sizes
Nails, if requested
Wire, gauges 30, 32, 34, and 35
Nail cutter for nails and wire
Bolt, nuts, and wrench, if requested

Bone Grafting.—The setup includes open reduction and plating setup, plus the following:

Electric motor saw with circular twin and angular blades and drill points
Hand drill and drill points Nos. 8, 9, and 10
Bone curettes, various sizes
Bone-cutting forceps
Bone-holding forceps
Osteotomes, chisels, gouges to suit the extremity (Fig 483)
Mallet
Parham-Martin bands, optional
Scalpel handle No. 4 with blade No. 22
Asepto syringe, 2 ounces
Normal saline solution
Wooden board
Basin set
Orthopedic draping pack
Minor operating pack
Gown pack
Glove set
Sutures for wound closure
Dressings
Plaster cast setup

Suture Fixation.—The setup includes a basic open reduction setup, plus the following:

3 Drill and drill points, suitable sizes
2 Parham-Martin bone-holding clamps
4 Parham-Martin bands
2 Wire or tendon passers
1 Wire-cutting forceps
1 Harris wire tightener
1 Shifrin wire twister
1 Heavy scissors

Sutures

For *knee:* Stainless steel wire gauge 18 or 20 (3-0 or 2-0)
For *olecranon:* Stainless steel wire gauge 24 or 26 (3-0), or chromic gut No 1 or 2
For *joint capsule.* Chromic gut No. 3-0, 2-0, or 0, or silk No. 2-0 or 3-0; or wire No. 5-0 or 4-0

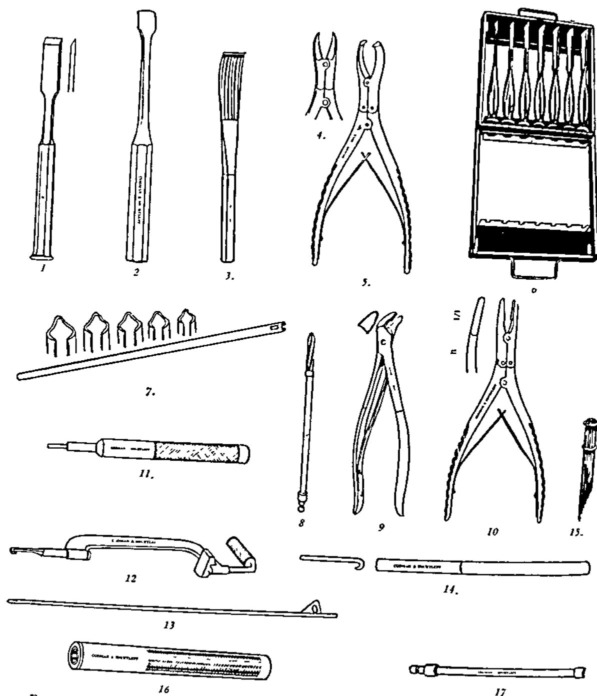


Fig 483—Orthopedic instruments, including chisels, osteotomes, and gouges for hip operations. *1*, Hibbs bone chisel, available sizes ⅜, ½, ⅝, ¾, 1, 1¼, and 1½, each 8¾ inches, *2*, Key periosteal elevator, length 7½ inches, width ¼, ½, ¾, or 1 inch; *3*, Meyerding bone skid, 7¼ or 9¾ inches, *4*, Chang double-action bone-cutting forceps, slightly curved jaw, 7½ inches; *5*, Hibbs double-action bone-cutting forceps, 7 inches, *6*, Smith-Petersen osteotome in case, *7*, Kuntscher cloverleaf-type pins, available in 12, 11, 10, 9, and 8 mm. widths, and lengths ranging from 26 to 52 cm, *8*, medullary canal reamer, sizes 9, 10, 11, 12 mm. diameter, by 10 inches, used to remove irregular projections or callus in the canal so that the pin can be introduced with less trauma; with brace designed for use with pins; *9*, Bacon angular rongeur; *10*, Smith-Petersen double-action bone rongeur, available sizes 7½ or 9½ inches, straight, slightly curved, or full curved jaw, *11*, pin set for use with Kuntscher cloverleaf-type intramedullary pins of 9, 10, 11, and 12 mm diameter, *12*, extractor for use with Kuntscher cloverleaf-type and V-type intramedullary pins, *13*, femur guide pin with trocar point for use with various-sized Kuntscher pins, and handle for use with Jacobs chuck, *14*, driver for Rush intramedullary pin; *15*, Rush medullary pins with rack for various lengths for long and short fractured bones; *16*, driver for use with Kuntscher cloverleaf-type and V-type intramedullary pins; *17*, trochanteric counterbore or reamer available in sizes 9, 10, and 11 mm diameter and 8 inches long (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

1 Bone awl
1 Stille-Sherman or Zimmer-Kirschner drill
2 Chuck keys
1 Drill gauge (Fig. 481)
1 Drill guide for bone plates or grafts
1 Lane screw-holding forceps
2 Lane plate-bending forceps
1 Electric motor saw and drill attachments with drill points
1 Electrocoagulation machine and attachments, optional
1 Screw starter
2 Screwdrivers for Sherman, Wood, Woodruff, or cross-lot slot head, or Phillips screws
Plates, 18-8 SMO stainless steel or vitallium, straight or curved, of proper width and size (Fig. 482), i.e.—
For *small bones*, plates with 2, 3, and 4 openings
For *large bones*, plates with 4, 6, or 8 openings or Venable, Sherman, Eggers contact splint, or Acme slotted type
Screws, Venable type, self-tapering, with 20 to 32 threads to the inch, or Phillips, or Sherman type, various lengths and diameter (Fig. 482)
Metal container for holding plates, screws, and drills
Drill points, suitable sizes
Nails, if requested
Wire, gauges 30, 32, 34, and 35
Nail cutter for nails and wire
Bolt, nuts, and wrench, if requested

Bone Grafting.—The setup includes open reduction and plating setup, plus the following:

Electric motor saw with circular twin and angular blades and drill points
Hand drill and drill points Nos. 8, 9, and 10
Bone curettes, various sizes
Bone-cutting forceps
Bone-holding forceps
Osteotomes, chisels, gouges to suit the extremity (Fig. 483)
Mallet
Parham-Martin bands, optional
Scalpel handle No. 4 with blade No. 22
Asepto syringe, 2 ounces
Normal saline solution
Wooden board
Basin set
Orthopedic draping pack
Minor operating pack
Gown pack
Glove set
Sutures for wound closure
Dressings
Plaster cast setup

Suture Fixation.—The setup includes a basic open reduction setup, plus the following:

3 Drill and drill points, suitable sizes
2 Parham-Martin bone-holding clamps
4 Parham-Martin bands
2 Wire or tendon passers
1 Wire-cutting forceps
1 Harris wire tightener
1 Shifrin wire twister
1 Heavy scissors

Sutures

For *knee:* Stainless steel wire gauge 18 or 20 (3-0 or 2-0)
For *olecranon:* Stainless steel wire gauge 24 or 26 (3-0), or chromic gut No. 1 or 2
For *joint capsule:* Chromic gut No. 3-0, 2-0, or 0, or silk No. 2-0 or 3-0; or wire No. 5-0 or 4-0

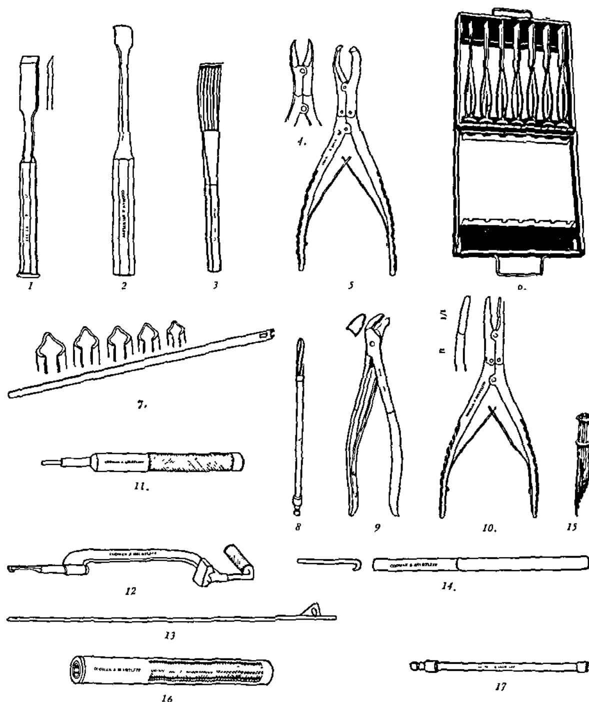


Fig. 483—Orthopedic instruments, including chisels, osteotomes, and gouges for hip operations *1*, Hibbs bone chisel, available sizes 3/8, 1/2, 5/8, 3/4, 1, 1 1/4, and 1 1/2; each 8 3/4 inches; *2*, Key periosteal elevator, length 7 1/2 inches, width 1/4, 1/2, 3/4, or 1 inch, *3*, Meyerding bone skid, 7 1/4 or 9 3/4 inches, *4*, Chang double action bone-cutting forceps, slightly curved jaw, 7 1/2 inches; *5*, Hibbs double-action bone-cutting forceps, 7 inches, *6*, Smith-Petersen osteotome in case; *7*, Kuntscher cloverleaf-type pins, available in 12, 11, 10, 9, and 8 mm. widths, and lengths ranging from 26 to 52 cm, *8*, medullary canal reamer, sizes 9, 10, 11, 12 mm diameter, by 10 inches, used to remove irregular projections or callus in the canal so that the pin can be introduced with less trauma; with brace designed for use with pins, *9*, Bacon angular rongeur; *10*, Smith-Petersen double-action bone rongeur, available sizes 7 1/2 or 9 1/2 inches, straight, slightly curved, or full curved jaw, *11*, pin set for use with Kuntscher cloverleaf-type intramedullary pins of 9, 10, 11, and 12 mm diameter, *12*, extractor for use with Kuntscher cloverleaf-type and V-type intramedullary pins, *13*, femur guide pin with trocar point for use with various-sized Kuntscher pins, and handle for use with Jacobs chuck; *14*, driver for Rush intramedullary pin; *15*, Rush medullary pins with rack for various lengths for long and short fractured bones; *16*, driver for use with Kuntscher cloverleaf-type and V-type intramedullary pins; *17*, trochanteric counterbore or reamer available in sizes 9, 10, and 11 mm. diameter and 8 inches long. (Courtesy Codman & Shurtleff, Inc., Boston, Mass)

1 Bone awl
1 Stille-Sherman or Zimmer-Kirschner drill
2 Chuck keys
1 Drill gauge (Fig. 481)
1 Drill guide for bone plates or grafts
1 Lane screw-holding forceps
2 Lane plate-bending forceps
1 Electric motor saw and drill attachments with drill points
1 Electrocoagulation machine and attachments, optional
1 Screw starter
2 Screwdrivers for Sherman, Wood, Woodruff, or cross-lot slot head, or Phillips screws
Plates, 18-8 SMO stainless steel or vitallium, straight or curved, of proper width and size (Fig. 482), i.e.—
For *small bones,* plates with 2, 3, and 4 openings
For *large bones,* plates with 4, 6, or 8 openings or Venable, Sherman, Eggers contact splint, or Acme slotted type
Screws, Venable type, self-tapering, with 20 to 32 threads to the inch, or Phillips, or Sherman type, various lengths and diameter (Fig. 482)
Metal container for holding plates, screws, and drills
Drill points, suitable sizes
Nails, if requested
Wire, gauges 30, 32, 34, and 35
Nail cutter for nails and wire
Bolt, nuts, and wrench, if requested

Bone Grafting.—The setup includes open reduction and plating setup, plus the *following:*

Electric motor saw with circular twin and angular blades and drill points
Hand drill and drill points Nos. 8, 9, and 10
Bone curettes, various sizes
Bone-cutting forceps
Bone-holding forceps
Osteotomes, chisels, gouges to suit the extremity (Fig. 483)
Mallet
Parham-Martin bands, optional
Scalpel handle No. 4 with blade No. 22
Asepto syringe, 2 ounces
Normal saline solution
Wooden board
Basin set
Orthopedic draping pack
Minor operating pack
Gown pack
Glove set
Sutures for wound closure
Dressings
Plaster cast setup

Suture Fixation.—The setup includes a basic open reduction setup, plus the following:

3 Drill and drill points, suitable sizes
2 Parham-Martin bone-holding clamps
4 Parham-Martin bands
2 Wire or tendon passers
1 Wire-cutting forceps
1 Harris wire tightener
1 Shifrin wire twister
1 Heavy scissors

Sutures

For *knee:* Stainless steel wire gauge 18 or 20 (3-0 or 2-0)
For *olecranon:* Stainless steel wire gauge 24 or 26 (3-0), or chromic gut No. 1 or 2
For *joint capsule:* Chromic gut No. 3-0, 2-0, or 0, or silk No. 2-0 or 3-0; or wire No. 5-0 or 4-0

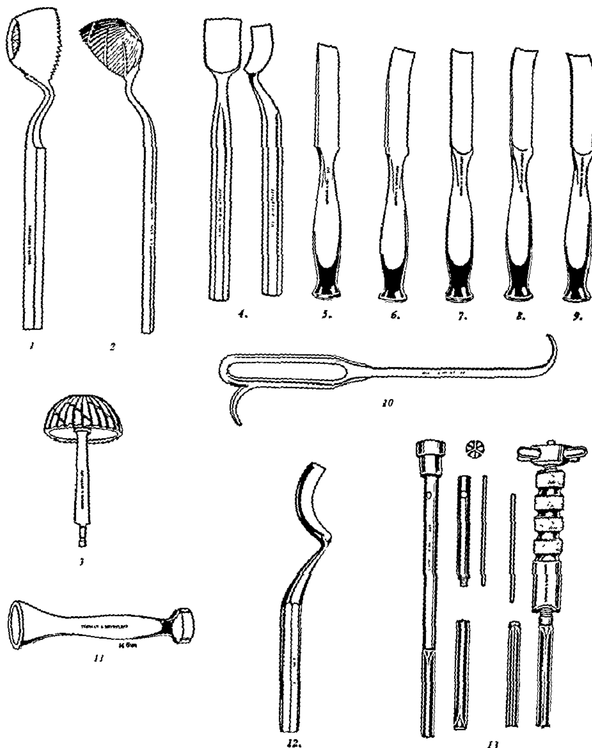


Fig 484.—Additional instruments for arthroplasty operations of the hip: *1*, Smith-Petersen deep cup reamer; *2*, Smith-Petersen ball reamer, available in sizes extra large, large, and small; *3*, Smith-Petersen hip reamer, available in sizes 1½, 1¾, 1⅞, 2, 2⅛, and 2¼ (fits Hudson brace); *4*, Smith-Petersen arthroplasty gouge, large size 1⅛ inches wide, or small ⅞ inch wide; *5*, Smith-Petersen osteotome, straight, 8 inches, and in various sizes, *6*, Smith-Petersen osteotome, curved, 8 inches, and in various sizes; *7*, Smith-Petersen gouge, straight, 8 inches, sizes 3/8, 9/16, 3/4, and 1 inch diameter; *8*, Smith-Petersen gouge, curved, 8 inches, available in sizes 3/8, 9/16, 3/4, and 1 inch in diameter; *9*, Smith-Petersen gouge, reverse curve, 8 inches, and in various sizes; *10*, hook and elevator used in conjunction with MacAusland retractor elevators for elevation of the femoral stump; *11*, Judet dissector, 7½ inches, curved or straight, *12*, Smith-Petersen arthroplasty gouge, short, for starting cut, ⅞ inch wide; *13*, Smith-Petersen nail-applying and nail-removing set Instruments as shown are one third actual size. (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

Fixation of Fractured Subcapital and Upper Mid-Femoral Neck (Smith-Petersen Hip-Pinning Operation)

The setup includes basic open reduction setup, plus the following:

2 MacAusland, Kelly, Hibbs, or Bennett retractors, size suitable to wound (Fig. 483)
3 Smith-Petersen nails, various sizes suitable to size of bone
2 Smith-Petersen guide pins or wires or modifications, preferably notched type
1 Metal ruler
1 Kirschner drill with calibrated wires
2 Chucks and key
1 Chuck pliers
3 Drill points, 5 to 8 inches
1 Starter
1 Impactor
Extractor
Mallet
Driver
Cannulated reamer for placing guide pin
Lorenz screw-blade
Nail and wire cutter
Nail retractor
Moore pins, elevator, retractor, and driver
Stainless steel wire sutures

Also

Cassette for operating table
Fracture table with leg and pelvis attachments, padding and bandage for foot and ankle
X-ray machine
X-ray markers

Fixation of Fractured Base of the Femoral Neck

The setup includes hip-pinning setup plus the following:

Meyerding retractors
Bennett retractors (Fig. 481)
Electric oscillating saw with chuck and drill points
Screwdrivers to suit screws (Fig. 481)
Single- or double-pronged fracture-holding forceps
Lane plate wrenches
Kirschner drill, calibrated wires and drill
Sherman or wood screws (Fig. 482)
McLaughlin, modified Smith-Petersen nail and plate, Jewett, Neufeld nail, or Blount-Moore blade plates of various sizes, pliers for extracting and bending plate, retractor, nail inserter or hip screws (Fig. 485)
Pushirons

Also

Orthopedic hip and leg pack
Stockinet for leg and hip
Extra sterile sheets to cover the patient to take x-rays

Fixation of Fractured Middle and Upper Femoral Shaft (Intramedullary Pinning)

The setup includes hip-pinning setup, hip and leg packs, plus the following.

Meyerding, Deaver, or Moore bone elevator and retractor, or Bennett retractor
Mallet
Electrocoagulation machine, if desired
Metal ruler
Kuntschner, Hansen-Street, Rush, or other triflange nail (Figs. 483, 486)
Long-handled reamers, sizes Nos. 9, 10, and 11
Cannulated guide pin
Nail starter
Long drill points
Drill with Jacobs chuck and key
Medullary nail extractor
Driver
Extension for tibial nail
Pliers, long handle and double-section
Parham-Martin bands
Saw with heavy blade

Setup for Reconstruction Operations on a Lower Extremity

Arthroplasty of a Hip.—The setup includes open reduction setup, hip and leg packs, plus the following:

2 Kelly tissue forceps, 7 inches
1 Mayo scissors, curved, 8½ inches
2 Smith-Peterson capsule retractors, posterior and inferior, or
2 Deaver retractors, wide blade, or
1 MacAusland muscle retractor, or
2 Meyerding retractors, large blade, 9 inches
2 Meyerding bone skids, 7¼ and 9¾ inches (Fig 482)
3 Putti or Smith-Petersen arthroplasty gouges, various sizes (Fig. 483)
1 Hudson brace to fit reamers
2 Murphy reamers, ball and cup types
1 Smith-Petersen hip reamer (Fig. 484)
2 Smith-Petersen or Austin-Moore cup reamers, desired type with hand brace
2 Smith-Petersen, Stille, or Abbott osteotomes, straight, curved, reverse curve (Fig. 484)



Fig 485—Intertrochanteric appliances. From left to right: Thornton, Neufeld, Jewett, and McLaughlin. (Courtesy Austenal, Inc, Surgical Division, New York, N. Y)

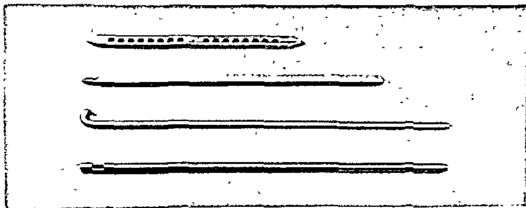


Fig 486—Intermedullary bars Top to bottom: Livingston, Diamond, hooked, cloverleaf (Courtesy Austenal, Inc, Surgical Division, New York, N Y.)

1 Meyerding osteotome, 10 inches, ⅝ inch wide
2 Campbell periosteal elevators, slightly curved and full-curved blades, 8 inches, 15 or 23 mm. wide
2 Smith-Petersen double-action rongeurs, narrow straight, slightly curved, or full-curved jaw, 9½ inches (Fig. 481)
1 Smith-Petersen alligator forceps, heavy type
1 Smith-Petersen or Meyerding mallet, 30 ounces, 8½ inches
1 Electric motor saw with several long burrs
Electrocoagulation machine
Smith-Petersen vitallium hip cups, or Austin intramedullary prosthesis, or metal Judet type, or other desired type
Extractor for removal of femoral head

Prosthesis of a Femoral Neck.—The setup includes arthroplasty hip setup, plus the following:

Hook and elevator for femoral stump (Fig. 487)
Endoprosthesis setter
Shelf reamer (Fig. 486)
Shaft reamer, corkscrew type
Bone skid, flexible type
Hip retractor, heavy and wide
Prosthesis, desired type and size (Fig. 487)



Fig 487.—Hip prosthesis. Top, left to right: Judet, Eicher, F. R. Thompson, and Austin T Moore Below: Moore rasp and hooked driver-extractor. (Courtesy Austenal, Inc, Surgical Division, New York, N. Y)

Arthrodesis of a Hip.—The setup includes open reduction setup, plus the following:

4 Hibbs or Deaver or Meyerding retractors
1 Mayo-Harrington scissors, 7 inches
1 Mayo scissors, curved, 8½ inches
1 Meyerding hip or Putti bone skid
1 Smith-Petersen or MacAusland muscle retractor
1 Amerson bone elevator and raspatory, 8½ inches long, ½ inch wide, optional
4 Lambotti or Campbell osteotomes (Fig. 483)
3 Campbell, Putti, or Smith-Petersen arthroplasty gouges (Fig. 484)

1 Judet or MacAusland sharp dissector (Fig. 484)
2 Abbott bone chisels, 3/4 inch wide, 8 1/2 inches long
1 Lane bone-holding forceps
2 Key periosteal elevators, 1/2 and 3/4 inch wide, 7 1/2 inches long (Fig. 483)
2 Hibbs curettes, long type
Smith-Petersen double-action rongeurs
Electric motor with saw, drill attachment, and drill points
Extractor for removing nail
Leg screws
Screwdrivers
Orthopedic leg and hip pack
Extra laparotomy pads
Hip spica setup
Corkscrew extractor

For Colonna Operation.—Add to arthodesis setup: Colonna or Smith-Petersen set of hip reamers and brace

Osteotomy on a Long Bone or Joint.—The setup includes open reduction setup, plus the following:

2 Alexander or Campbell chisels, suitable size
2 Lambotti osteotomes, straight, suitable size
1 Mallet
1 Kermisson rongeur
1 Smith-Petersen alligator forceps, heavy type
1 Adson cranial rongeur, optional
2 Bacon rongeurs, curved sideways
1 Bone impactor
1 Kirschner drill and drill points
Metal fixation appliances, desired type —leg screws, Neufeld nails and screws, or Kirschner wires, or plates and screws
Gigli saws and holders
Electric motor saw and blades
Bone graft setup, optional
Plaster setup

Femoral Shortening.—The setup includes the following:

Osteotomy setup
Kuntschner intramedullary pin setup (Fig. 483), or
Blount single-angled blade plate and Sherman screws (Fig. 482)
Bone-grafting setups
Double spica cast setup, if desired

Slipped Upper Femoral Epiphysis.—

(1) For fresh or early gradual slipping, the setup includes the following:

Smith-Petersen hip-pinning setup
Small caliber noncannulated Smith-Petersen nail, or Moore or Knowles pins

(2) For slipping with extensive displacement, the setup includes the following:

Smith-Petersen nail-pinning setup
Osteotomy instruments

(3) For epiphyseal arrest, the setup includes the following:

Open reduction setup
Staples
Blount holder, impactor, and remover (Fig. 488)
Electrocoagulation unit

Sequestrectomy for Osteomyelitis.—The setup includes a minor setup, suitable orthopedic draping pack, plus the following:

Drill and drill points, various diameters
Sequestrectomy forceps
Bone curettes
Syringe, 5 ml.
Asepto syringe, 2 ounces
Aspirating needle, blunt-point and
Methylene blue or other dye
Hydrogen peroxide
Antibiotic solution
Rongeurs
Chisel
Gouge
Mallet
Setup for removal of plates and screws, if required
Orthopedic dressing

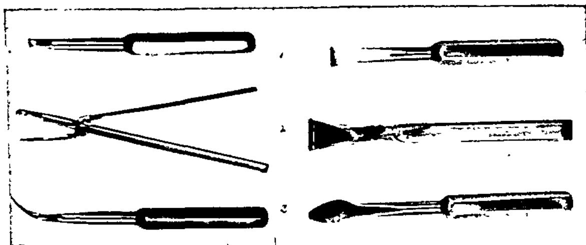


Fig 488.—Instruments employed in epiphyseal stapling. (Courtesy Dr. W. P. Blount, from Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, vol. I, St. Louis, 1956, The C. V. Mosby Co)

Setup for Arthrodesis of the Spine (Spinal Fusion)

The setup includes a minor dissecting setup, plus the following:

2 Gruenwald bayonet forceps, 1 with and 1 without teeth
1 Noyes alligator action forceps
2 Bone-cutting angular biting forceps, 1 open and 1 closed jaw
4 Hibbs retractors, suitable sizes (Fig. 489)
1 Frazier laminectomy retractor (Fig. 489)
2 Bone hooks, 1 sharp, 1 dull point
1 Bone tenaculum
3 Raspatories, 1 straight, 1 curved, and 1 double ended, blunt
4 Periosteal elevators, 1 narrow blade (Herczel), 1 slightly curved (Langenbeck), 1 broad and sharp (Lane), 1 blunt (Hibbs)
3 Chisels, various widths (Fig 489)
3 Gouges, various widths (Fig. 489)
3 Fusion elevators, triangular end
6 Spinal fusion chisels, various sizes, straight and curved (Fig. 489)
6 Spinal fusion osteotomes, various sizes, straight and curved
2 Hibbs-Spratt curettes, 1 straight No. 4-0, 1 angled shaft No 2-0 (Fig 490)
1 Bone mallet
4 Rongeurs—2 Hibbs, large and small jaw, 2 Bacon, curved upward and sideways (Fig. 490)
1 Drill and 2 long drill points
8 Bone screws, 4 or 4¾ inches
2 Screw drivers, suitable type
1 Awl
1 Metal ruler
1 Calibrated drill measurer
1 Wooden board } for preparing bone
1 Bone curette } graft

(Continued on page 728)

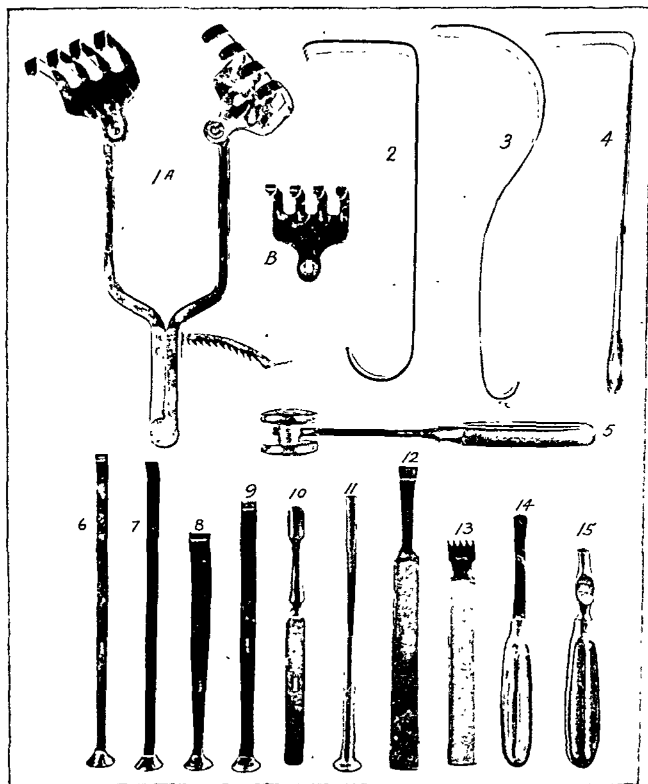


Fig 489—Instruments for spinal fusion and laminectomy *1*, Frazier adjustable blade retractor; *2*, Hibbs retractor, *3*, Deaver retractor, *4*, Lange retractor, *5*, hammer; *6*, angled chisel, *7*, angled osteotome, *8*, angled wide chisel, *9*, angled wide osteotome; *10*, Brun straight gouge; *11*, narrow bone gouge, *12*, long-handled chisel, *13*, raspatory, *14*, periosteal raspatory, *15*, Kirmisson raspatory.

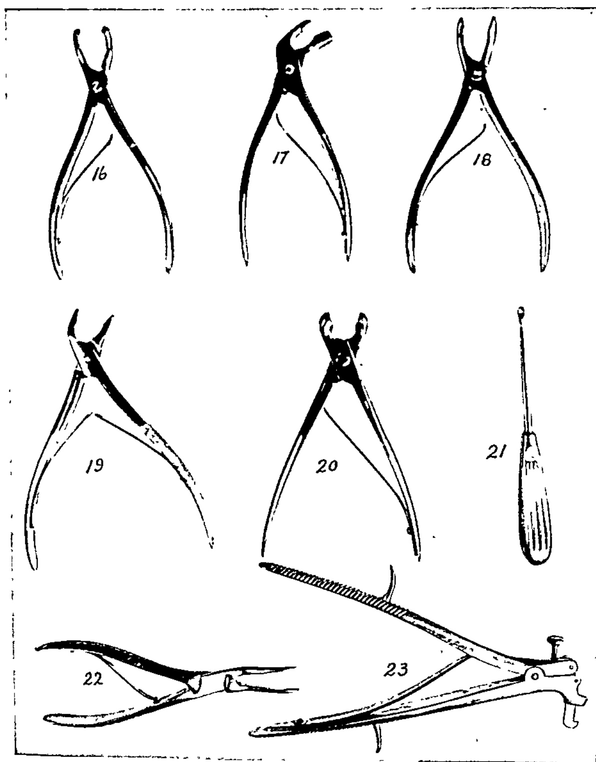


Fig 490 —Instruments for spinal fusion and laminectomy—cont'd *16,* Markwalder bone-cutting forceps; *17,* Barnhill angular mastoid bone-cutting forceps; *18,* Luer rongeur forceps; *19,* Bacon mastoid rongeur forceps, *20,* Luer heavy rongeur forceps, *21,* curette; *22,* long-angled rongeur forceps. *23.* Hudson bone forceps

1 Asepto syringe, 2 ounces
2 Tubes bone wax

Also

Orthopedic major pack
Orthopedic leg pack for bone-grafting procedure
Fenestrated spinal sheet
Spinal fusion pads, various sizes
Compressed cotton strips, various sizes
Glove set
Gown set
Basin set
Skin preparation setup

Setup for Aspiration of a Joint

The setup includes a minor dissecting setup, plus the following:

1 Local anesthetic set including
Syringes, needles ½ or 1 per cent Novocain solution, and graduated flask, 2 ounces
1 Tray cover
1 Minor basin set
2 Sponge-holding forceps
1 Scalpel handle No. 3 with blade No. 11
1 Tissue forceps without teeth
1 Scissors
3 Aspirating needles—1, gauge 20, 2½ inches; 2, gauge 16 or 14, 3 or 4 inches
2 Syringes—1, 10 ml.; 1, 30 ml.
Normal saline solution
6 Surgical towels
8 Gauze compresses, 4 by 4 inches
Gloves
Skin preparation setup
Dressings and 2 cotton elastic bandages

Setup for Arthrotomy of a Joint

The setup includes a minor setup, plus the following:

1 Orthopedic pack (arm or leg)
1 Minor operating pack
1 Glove set
1 Gown set
1 Minor basin set
1 Stryker meniscus knife
1 Downing cartilage knife, suitable size
2 Bone curettes
2 Periosteal elevators, curved
2 Bone vulsellum forceps
1 Lewin bone hook

Also

Plaster cast setup, or
Cotton elastic bandages

Setup for Coccygectomy

The setup includes a minor dissecting setup, plus the following:

2 Volkman retractors, 2-pronged, dull points
1 Carroll self-retaining retractor, optional
2 Ochsner forceps
2 Bayonet forceps
1 Heavy scissors, long blade
2 Curettes
1 Joplin bone-holding forceps (Fig. 481)
1 Key periosteal elevator (Fig 483)
1 Chang or Liston-Stille bone-cutting forceps, 7 inches (Fig. 483)
1 Luer or Bacon rongeur (Fig. 483)
1 Chisel
1 Gouge
1 Mallet
1 Fenestrated laparotomy or vein sheet
1 Minor operating pack
1 Minor basin set
1 Gown pack
1 Glove set

Setups for Operations on the Knee, Elbow, or Shoulder

Basic Setup.—The kind, number, and size of the orthopedic instruments and draping sheets will depend upon the size of the injured structures and their location. The setup should include the following:

2 Israel retractors
2 Meyerding retractors, small size
2 Love knee retractors, suitable size
1 Myers knee retractor, optional
2 Bennett or Hibbs retractors, suitable sizes (Fig. 481)
1 Langenbeck retractor, blunt, slender type
8 Towel forceps
3 Scalpels, 2 handles No. 4 with blades No. 20, 1 handle No. 3 with blades Nos. 10 and 11
24 Skin clips and 2 holders, optional
3 Tissue forceps with 2 and 3 teeth, 5½ inches
3 Dressing forceps—2, 5½ inches; 1, 7 inches
1 Bayonet forceps, with teeth
2 Mayo scissors, curved, 5½ inches
1 Mayo-Harrington scissors
1 Mayo scissors, straight, 6½ inches
2 Cartilage scissors, 7¼ or 5¾ inches
1 Martin cartilage clamp
1 Lewin bone clamp
1 Dental periosteal elevator
1 Bone hook
8 Sponge forceps
12 Crile artery forceps, straight, 5½ inches
6 Mayo-Pean artery forceps, 6½ inches
2 Ochsner artery forceps
3 Mayo-Hegar needle holders
2 Curettes, suitable size, straight and curved
3 Hibbs, Meyerding, or Lambotti osteotomes, ⅓, ⅜, and ½ inch wide, 10 inches long
2 Meyerding, or U.S.A. chisels, ⅓ or ⅜ inch long
3 Meyerding, Stille, or Murphy gouges, ⅓, ⅜, ½ inch wide, 8¼ inches long
1 Smith-Petersen alligator forceps
2 Tendon passers
1 Nicola tendon clamp, if desired
1 Chang, Bacon, or Smith-Petersen bone-cutting forceps
1 Luer or Bacon rongeur, slightly curved jaw
1 Meyerding *bone skid, 7¼ inches* (Fig. 483)
1 Stille-Sherman, or Kirschner-Zimmer drill and drill points Nos. 6, 9, 10, and 12
2 Abbott elevators, slightly curved and medium curved, 7¾ inches
1 Bone awl
2 Key or Crego curved periosteal elevators
1 Drill and drill points
2 Gigli saws, 12 inches, and holders
1 Asepto syringe
1 Tenotomy knife
Electrocoagulation unit, *optional*

Textiles, Sutures, Basins

Major operating pack
Major basin set
Gown pack
Glove set
Orthopedic leg pack
Martin bandages, optional
Sutures—silk and chromic gut Nos. 4-0 to 0,
Stainless steel wire, if desired
Nylon No. 6-0 for skin closure
Surgical orthopedic dressing set

Other Items

Supports and pillow
Pneumatic (Robbins) tourniquet
Velpeau bandage, if required
Plaster cast setup, if required
Cotton elastic bandages

Setup for Open Reduction and Fixation on the Foot or Hand

The Basic Setup.—*The standard basic setup should be suitable to the structures involved and should meet the preferences of physicians.* The setup should include the following *items.*

Instruments

2 Scalpel handles No. 3 with blades Nos. 10 and 15
1 Scalpel handle No. 4 with blade No. 20, if desired
1 Ryerson tenotomy knife, optional
2 Volkman retractors, suitable size
2 Little retractors
2 Senn double-ended retractors
2 Mayo-Collins retractors, optional
1 Single-prong retractor
1 Carroll self-retaining retractor, optional
1 Mayo scissors, curved, 5½ inches
1 Katzeff cartilage scissors, 5¾ inches, optional
1 Martin cartilage clamp for long joints
1 Lillie and Boettcher scissors, 7 inches
3 Tissue forceps, 1 and 2 teeth, 5½ inches
1 Dressing forceps, 5½ inches
1 Bayonet forceps
1 Webster needle holder
6 Kelly artery forceps, curved, 5 inches
6 Halsted mosquito artery forceps, 5 inches
2 Allis forceps
6 Towel forceps
6 Sponge-holding forceps
1 Stryker saw, small type
1 Lewin or Joplin bone clamp
1 McKenty periosteal elevator
1 Kirschner or Bunnell hand drill with rotating spool
2 Drills, trocar points No. 3/32 or dental drills
1 Jacobs hand chuck and key
Kirschner wires, fine caliber, assorted sizes
1 Hibbs bone-cutting forceps, double-action, 7 inches
1 Smith-Petersen, Luer, or Bacon rongeur, double-action, 1½ inches, slightly curved jaw
2 Brun curettes Nos. 3-0 and 2-0

For Arthrodesis, add

Staples, if requested
1 Carroll-Legg osteotome, for hand
2 Meyerding, Campbell, or Hibbs osteotomes, sizes ⅓ and ⅜ inch wide, 6¾ or 7 inches long
2 Meyerding or Stille gouges, sizes 5 and 14 mm. wide
2 Meyerding, Stille, or Keyes chisels, sizes ⅜ and ½ inch wide
1 Carroll or Meyerding aluminum mallet
Bone-grafting setup, if desired.
Bone-plating setup, if desired
Bone wax
Sutures, as for open reduction on lower extremity

Other Sterile Items

Minor operating pack
Orthopedic hand or foot pack
Stockinet
Basin set
Gown pack
Glove set
Orthopedic dressing set

Setup for Amputation of an Extremity

The type and size of the instruments and textiles selected to remove a portion or all of a bone must be suitable to the involved area. The basic setup should include the following:

For Long Large Bones

4 Retractors, suitable size (Fig. 491)
2 Tissue forceps with 1 and 2 teeth
2 Tissue forceps without teeth
2 Scalpels, suitable size
2 Mayo scissors
1 Heavy or fine dissecting scissors
6 Mayo-Pean artery forceps, curved
4 Allis forceps
2 Ochsner forceps, optional
1 Bone shears (Fig. 492)
1 Amputation knife, narrow or wide blade (Fig. 492)
1 Electric motor saw, optional
1 Putti rasp
2 Periosteal elevators (Fig. 491)
1 Kirmisson raspatory (Fig. 491)

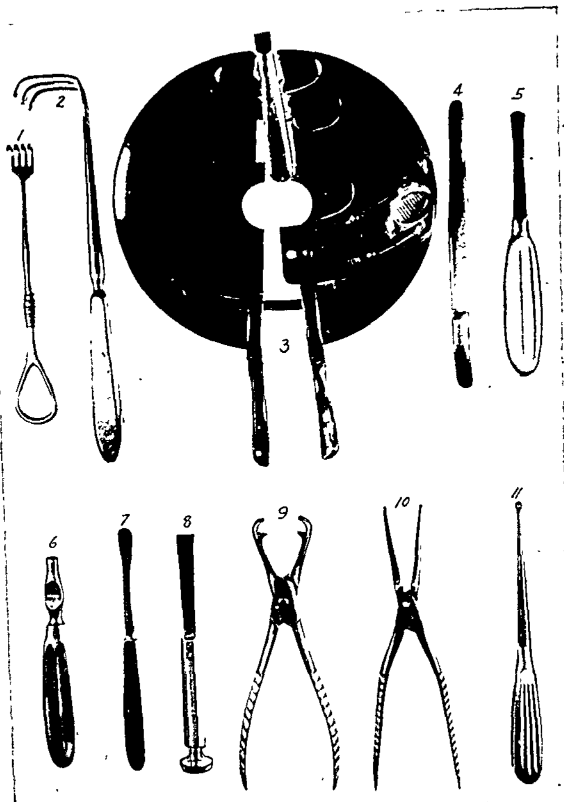


Fig 491—Instruments for amputation of an extremity: *1*, Volkman sharp retractor; *2*, Billroth retractor; *3*, Percy retractor, *4*, Sayre periosteal elevator; *5*, Hopkins periosteal raspatory; *6*, Kirmisson periosteal raspatory; *7*, Sedillot periosteal elevator; *8*, chisel; *9*, Ferguson bone-holding forceps; *10*, sequestrum forceps; *11*, curette.

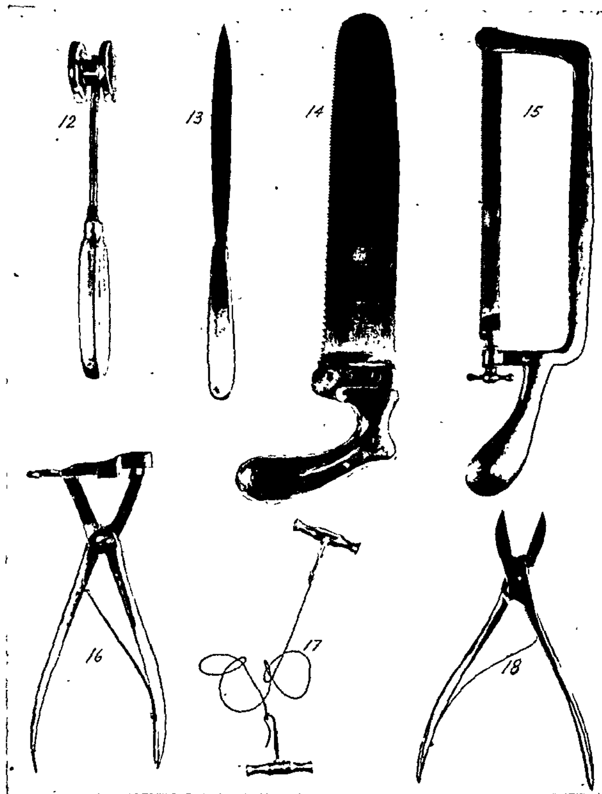


Fig. 492—Instruments for amputation of an extremity—cont'd *12*, hammer; *13*, amputation knife; *14*, Satterlee amputating saw, *15*, Charrière amputating saw; *16*, Schoemaker rib-cutting forceps; *17*, Gigli wire saw and handles; *18*, Liston bone-cutting forceps.

1 Lane bone-holding forceps, optional
1 Bacon or Luer rongeur
1 Bone curette
1 Asepto syringe
Bone wax
1 Aspirating needle, gauge 22, 3 inches
1 syringe, 5 ml.
Alcohol, 95 per cent, or
Novocain solution, 10 per cent
Major operating pack
Major basin set
Glove set
Gown set
Orthopedic leg or arm pack
Intravenous solutions and blood
Infusion and transfusion sets
Dressing set

Also

Support and pads
Basin for specimen
Laboratory tags for specimen
Splint for extremity
Signed operative consent sheet

For Small Bones

As for long bones, except smaller-sized retractors, hemostats, and dissecting instruments

Setup for Operations on Tendons and Soft Tissues

For Arm or Leg Structures.—The basic setup should include the following:

2 Volkman retractors
2 Roux or Parker retractors
2 Senn retractors
2 Greene or Murphy retractors
1 Carroll self-retaining retractor
2 Hook retractors, single-prong
2 Tissue forceps, 1 and 2 teeth, 5½ inches
1 Russian forceps, 6 or 7 inches
2 Dressing forceps, 5½ inches
1 Scalpel, handle No. 4, blade No. 20 (Fig. 493)
1 Scalpel, handle No. 7, blades Nos. 11 and 15
1 Ryerson tenotomy knife
1 Mayo or Kahn scissors, curved, 5½ inches
1 Mayo scissors, straight, 5½ inches
1 Katzeff cartilage scissors (Fig. 494)
1 Metzenbaum or Lillie scissors, 7¼ inches
6 Halsted artery forceps, straight, 5 inches
6 Rankin artery forceps, straight, 6½ inches
4 Mayo-Pean artery forceps, curved, 6½ inches
2 Allis-Adair tissue forceps, 9 and 10 teeth, 6 inches, optional
5 Sponge-holding forceps
6 Towel forceps
2 Needle holders
2 Tendon passers, pliable
2 Tendon hooks (Fig. 494)
Nerve tape
1 Asepto syringe
Orthopedic needle and plastic needle setup
Silk, stainless steel, and chromic gut suture materials sizes 5-0 and 6-0
Orthopedic pack to suit extremity
Glove and gown set
Major operating pack
Small gauze sponges
Basin set

Also

Pneumatic tourniquet (Robbins)
Martin bandage, optional
Sponge-rubber pads } for support
Armrest for arm } for support
Cotton elastic bandages
Plastic splint

For Repair of Tendon and Nerves of Hand.—The basic setup should include the following:

2 Volkman or Cushing vein retractors
2 Little retractors
2 Meyerding or Crile finger retractors, appropriate size
1 Senn double-ended retractor, 5 inches
1 Scalpel, handle No. 3, blades Nos. 10, 11, and 15

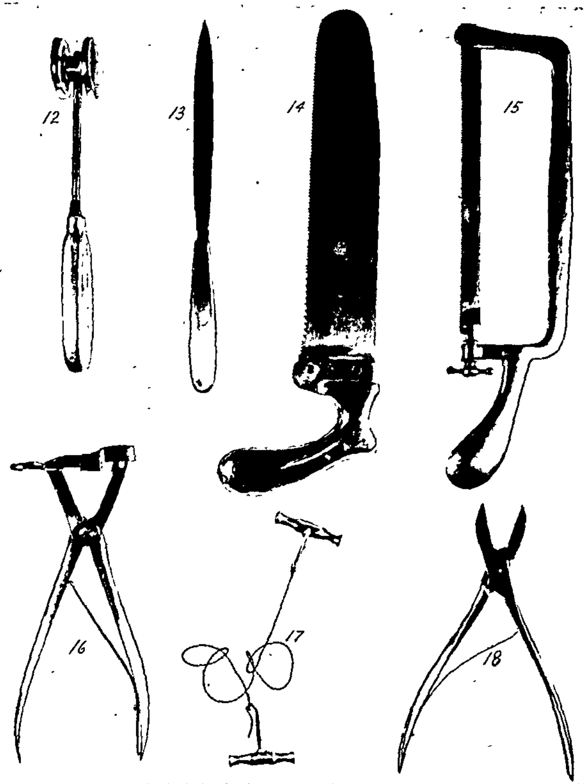


Fig. 492—Instruments for amputation of an extremity—cont'd· *12*, hammer; *13*, amputation knife, *14*, Satterlee amputating saw, *15*, Charrière amputating saw; *16*, Schoemaker rib-cutting forceps; *17*, Gigli wire saw and handles; *18*, Liston bone-cutting forceps.

6 Pearl buttons, small size, 2-eyed
Gunshot, varying sizes, and splint type
2 Tendon passers, pliable
1 Carroll aluminum mallet
1 Asepto syringe, 1 ounce

Sutures and Needles

Bunnell needles, plastic taper-point and cutting-edge, fine monafilament stainless steel No. 5-0, gauges 32, 34, 35, 38 and 40; silk Nos. 5-0, 4-0, 3-0; nylon Nos. 6-0, 5 0, 4-0; plain gut Nos. 5-0 and 4-0.

Other Sterile Items

Major operating pack
Glove set
Gown pack
Arm drape pack, stockinet, small compresses, and small swabs
Infusion set, normal saline solution
Syringes and needles for Novocain injection
Novocain and Adrenalin solutions
Hand dressing set

Unsterile Items

Pneumatic tourniquet (Robbins)
Aluminum arm and hand splints, if desired
Plaster-of-Paris cast or elastic cotton bandages
Armrest and pads for supporting shoulder joint and lumbar curvature
Stools for surgeons
Electrocoagulation unit
Operating floor lamp

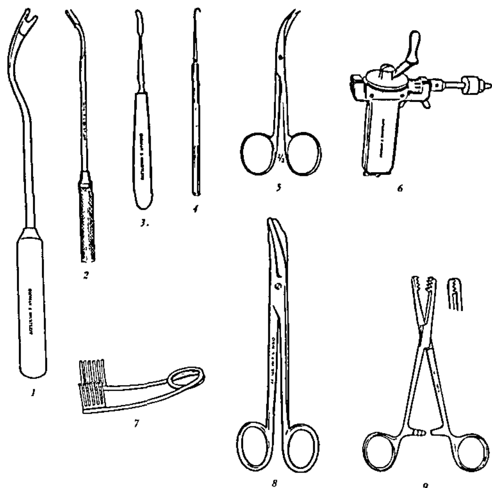


Fig 494 Instruments for operations on the cartilage. *1*, Downing cartilage knife, 7 inches; 2, Carroll tendon stripper, curved, 8¼ inches, sizes 1 and 2, *3*, McKenty periosteal elevator; *4*, Carroll hook, *5*, side-curved scissors, 4 inches, sharp points, *6*, Bunnell hand drill cannulated for Kirschner wires with screw chuck; *7*, Volkman pronged retractor, 2, 3, 4, or 6 prongs, dull or sharp points, 4½ inches, *8*, cartilage scissors, *9*, Martin cartilage clamp (Instruments shown here are one third actual size) (Courtesy Codman & Shurtleff, Inc, Boston, Mass)

1 Scalpel, handle No. 4, blade No. 20
1 Dressing forceps, narrow points, $5\frac{1}{2}$ inches
1 Carroll or eye-dressing forceps, straight, $5\frac{1}{2}$ inches (Grafe)
2 Carroll or eye tissue forceps, angular and straight type, fine teeth, $5\frac{1}{2}$ inches
2 Stevens tenotomy scissors, straight and curved, 4 inches
1 Knapp strabismus scissors, curved, blunt points, $4\frac{1}{2}$ inches, optional
1 Katzeff cartilage scissors, $5\frac{3}{4}$ inches
1 Suture and wire scissors
2 Johnson or Carroll skin hooks, 6 inches (Fig. 494)
1 Carroll offset hand retractor or Love nerve retractor
1 Carroll or Crile-Wood needle holder, light weight, $4\frac{3}{4}$ or 6 inches
1 Webster needle holder
6 Halsted (mosquito) forceps, curved fine points, 5 inches
6 Rankin-Kelly forceps, curved, $6\frac{1}{4}$ inches
6 Rankin-Kelly forceps, straight, $6\frac{1}{4}$ inches
2 Allis forceps
3 Sponge-holding forceps
8 Towel forceps
1 Carroll-Legg osteotome
1 McKenty or Freer periosteal elevator
1 Carroll or Killian periosteal elevator (Fig. 494)
1 Bunnell or Carroll hand drill (Fig. 494)
3 Twist drills, sizes $\frac{1}{16}$, $\frac{3}{32}$, and $\frac{1}{8}$ inch
3 Kirschner wires, trocar-point, sizes .035, .045, and .062, and Jacobs hand chuck
1 Bunnell chuck for drill
1 Stryker saw blade
1 Hibbs double-action bone-cutting forceps (small size)
1 Smith-Petersen rongeur, double-action, 7 inches (optional)
1 nerve elevator and scraper
Bunnell gouge set

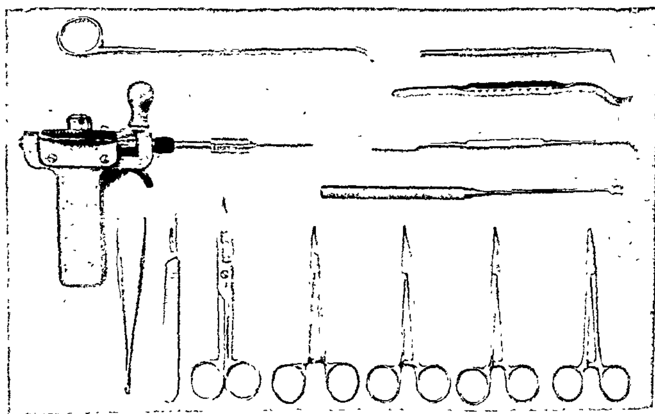


Fig 493—Operations upon small structures (tendons, nerves, and bones of hand and wrist) require fine instruments (From Speed, J S, and Knight, R A Campbell's Operative Orthopaedics, St Louis, 1956, The C V Mosby Co)

Normal saline solution
Cellophane squares
Silver foil, optional
Compresses, 4 by 8 inches
Compression dressing set

Needles and Sutures

Keith needles, surgeon's cutting-edge needles, 3/8-curved and silk; stainless steel wire or nylon, Nos. 5-0 and 6-0; swaged-on needles and sutures, if desired

For Wolfe-Krause (Full-Thickness Graft) and Ollier-Thiersch (Thin Graft).—Add the following:

(1) 2 skin boards for traction, 2 Ferris-Smith or Webster knives, or razor graft knives and holder
(2) Blair (suction-box), Blair suction apparatus and rubber tubing, suction machine, Blair retractors
(3) Reese dermatome with blades, brush and compound; or Padgett-Hood dermatome with blades and blade clip, brush, and cement; or Brown electrodermatome with motor attachments, blade wrench and blades

For Pedicle Graft and Flaps.—Basic grafting setup.

For Reverdini-Davis Pinch Graft.—Minor dissecting setup, plus 6 Keith needles, each 3 inches long; 2 razor blades and holder or Webster skin graft knife handle and blades.

INITIAL PREOPERATIVE SKIN PREPARATION

The principles of skin preparation are described and illustrated in Chapter 3. In preparing the orthopedic patient for surgery the standard skin cleansing procedure is carried out (Fig. 12). The procedure must be carefully carried out to prevent wound infection, since in bone surgery improper cleansing may result in dysfunction of an extremity joint or in disfigurement. Frequently the involved skin area has been exposed to soiling, or the patient has worn a plaster cast or an orthopedic appliance for a long time. In some cases the lesion or injury involves the thick horny epidermis in which dirt becomes easily embedded.

In preparing some patients for surgery it is necessary to cleanse the proposed operative site with a non-irritating soap or detergent once a day for one or two days prior to the scheduled time of operation. The rules of body cleanliness and frequent changing of bed linen and clothing are important aspects of proper preoperative skin care (Chapters 2 and 3).

In some cases, to protect the site from contaminants, after daily cleansing the site is encased in sterile towels or a slip-on cover. The sterile cover must completely envelope the prepared region without causing the patient discomfort. The cover should be designed so that it is easy to apply and remove.

The Regions to Be Prepared.—To ensure asepsis during surgery, the proposed operative site and the immediate region above and below should be cleansed (Fig. 12).[4, 7, 16, 17] The skin area to be prepared for various operations includes the following:

For operations on the toes, the extremity should be prepared to just below the knee. For operations on the foot and ankle, the leg should be prepared

Setup for Intraosseous Venography

The basic instruments as shown in Fig. 495, plus towels and skin preparation tray.

Setup for Skin-Grafting Operations

The basic setup should include the following:

2 Scalpel handles Nos. 4 and 3, with blades Nos 20, 10, and 11
2 Tissue forceps, 1 and 2 teeth, 4½ inches
2 Dressing forceps, narrow points, 5½ inches
2 Carroll tissue forceps, straight, 5½ inches
1 Mayo scissors, 5½ inches, straight
1 Metzenbaum scissors, 7 inches
1 Suture scissors, straight
1 Probe
8 Towel forceps
4 Sponge-holding forceps
2 Crile-Wood needle holders
6 Halsted mosquito clamps, straight
6 Crile artery forceps, 6 inches
4 Rankin-Kelly forceps
1 Ruler
1 Metal square or tray 10 inches long, 5 inches wide
Local set and 1 per cent Novocain, or Xylocaine solution
Xeroform gauze, fine mesh
Scarlet red ointment, if desired
Petrolatum, if desired

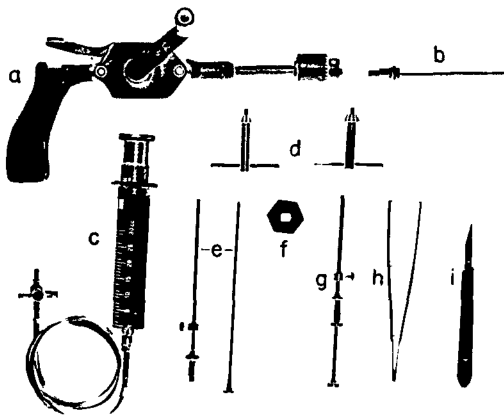


Fig 495—Instruments for intraosseous venography Turkel bone marrow needles iliac crest outer biopsy needle (*b*) used with Smeaberg drill (*a*), vertebral inner needle, needle stylet (*e*), and tibial inner needle (*g*) Chuck key (*d*) for tightening drill Scalpel with blade No. 11 (*i*). 30 ml. Luer-Lok syringe, attached polyethylene tubing and stopcock (*c*). Knurled extension handle (*f*) is part of Turkel set; it aids in hand penetration of bone. Tissue forceps (*h*) without teeth (From Salzman, F H, and Wise, R. E: S Clin North America 36:801, 1956)

steps of the procedure. They should understand the meaning of such terms as flexion, abduction or adduction, and rotation, so they can manipulate the operating table and apply attachments and other supports correctly.

The selection of the positions depends on several facts: (1) the type of operation to be performed, (2) the location of the injury or lesion, and (3) the age and physical condition of the patient. Positions commonly used include a supine (Chapter 4), lithotomy, Trendelenburg (Chapter 15), or a lateral or prone position (Chapter 9).

Positions.—For operations on the shoulder, the patient is usually placed in a supine or semilateral position, with the affected side near the edge of the operating table. The affected shoulder, arm, and back region are supported by pads, and the unaffected arm and the legs are stabilized.

For hand operations, the patient is placed on the operating table in a supine position, with the affected arm extended on an armrest at not more than an 80-degree angle to the body (Chapter 4).

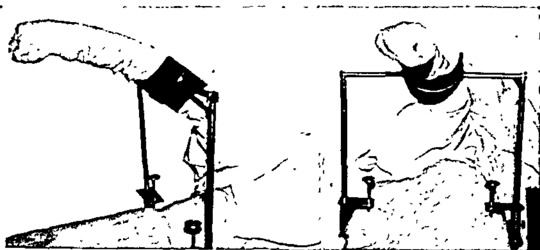


Fig. 496—Janes abduction frame in use (From Janes, J. M: Proc. Staff Meet. Mayo Clin. 28:45, 1953.)

For operations on the back, the patient may be placed in a prone position. For operations on the hip or leg, the patient may be placed on a fracture table, with the legs supported and stabilized in supports attached to the table. Pressure and strain on the nerves and muscles of the extremities and the spinal curvatures can be diminished by using sufficient padding and adjusting the appliances at a correct angle. The Janes abduction frame is effective in maintaining a lower extremity in an abducted position during a hip operation or when the patient is in a side-lying position (Fig. 496).

IMMEDIATE SKIN PREPARATION IN THE OPERATING ROOM

After the patient has been anesthetized and positioned properly on the operating table, the assistant operator cleanses the prepared operative site, using a detergent or soap and water together with a germicide. To prevent further bodily injury and possible contamination, and to conserve operating time, the

from the knee downward. In preparing the feet of children who have been going barefoot, the feet may be soaked in a suitable antiseptic solution twice a day for several days prior to surgery. After soaking, the feet should be dried thoroughly and exposed to the air. In some cases the patient (unless he has been immunized previously) may be given a dose of tetanus antitoxin on the day before the scheduled time of the operation.[4,7]

For operations on the knee region, skin preparation includes the area extending from the ankle or toes to the groin, including the pubic region.[3,4,7,10] The pubic hair is not removed. If a bone graft is to be taken from the tibia, the entire leg is prepared from the ankle to above the knee.

For operations on the hip regions, the skin preparation includes the area from the midline of the abdomen at a level above the umbilicus, also the back region, the buttock on the affected side, and the affected leg down to below the knee (Fig. 12). The pubes, gluteal cleft region, abdomen, thigh, and back regions are shaved.

For operations on the shoulder, the skin preparation includes the surfaces over the back and front of the neck and the adjacent posterior aspect of the upper back, anterior upper thorax, axilla, and arm on the affected side (Fig. 12). In some clinics the preparation includes the forearm and hand.[9,11,14]

For operations on the arm, elbow, forearm, or any area distal to the shoulder, the entire extremity is cleansed. In some clinics, for operations on the fingers, the surfaces from the mid-arm to the fingertips are prepared.[15]

For operations on the sacroiliac and lumbosacral regions, the area includes the proximal end of the gluteal fold to the level of the mid-dorsal vertebras.[19-21]

For operations on other areas of the spine, the back is prepared at least within a level of five vertebras both above and below the proposed operative site, and laterally over the chest region. For operations on the cervical portion of the spine or for operations in the upper thoracic region, the occipital area is cleansed also.

If the operation is to be made through an opening in the cast, its raw edges should be cut away and bound off with adhesive tape, and the exposed skin area should be cleansed thoroughly.[3,4,7]

For operations on compound fractures, the wound is immediately covered with a sterile dressing, and no attempt is made to clean it until after the patient has been anesthetized.[3,4,15,21-27]

For burn cases, the cleansing procedure is a part of the initial débridement that is performed immediately to remove contaminants and encourage the clean surfaces to develop firm granulation for later reception of skin grafts.[18]

POSITIONING OF THE PATIENT FOR ORTHOPEDIC SURGERY

Considerations.—When a patient is placed on the operating table, the position should provide for good body alignment, adequate exposure of the operative site, and freedom of respiratory and circulatory functions (Chapter 4). Positioning of the patient is primarily the over-all responsibility of the physician; however, his assistants should know how to carry out the actual

1 Dressing forceps
1 Scissors
Gloves
Gown
Distilled water
Normal saline solution
2 Sheets
4 Towels
Dressing set
Gauze bandages

Also

Detergent of choice
Sterile water
Infusion standard
Bucket
Plastic sheeting
Body supports
Plaster-of-Paris or synthetic mold material
Infusion of 5 per cent glucose and normal saline
Injection of morphine sulfate, as ordered
Prophylactic agent, as ordered
Compressure dressing

Procedure.—In caring for the patient with a lacerated wound, the assistants make him as comfortable as possible on the operating table or stretcher. His body is stabilized and the extremities supported. The physician, who has scrubbed and put on a sterile gown and gloves, drapes the site with sterile sheets, washes and irrigates the wound thoroughly, removes the devitalized tissue, and applies sterile dressings.

Wounds of six hours' duration or longer are usually prepared in the same manner, except that a germicide, such as a 1 per cent solution of aqueous iodine, may be applied to the surrounding surfaces of the wound after it has been thoroughly washed.[19-28]

DRAPING PROCEDURE FOR ORTHOPEDIC SURGERY

Draping the patient with sterile sheets and towels is the third important step in the operation.[3, 4, 9] Sterile linen packs needed for various operations should be standardized (Chapter 4).

The personnel who carry out the procedure should know how to handle sterile sheets and how to place them on the patient to provide for a sterile field. Practice is needed in arranging the sterile sheets so that they will remain securely in place during the operation and also provide adequate exposure of the operative site (Chapter 4).

To conserve the time needed to prepare the sheets and apply them over the patient, double-thickness or single-thickness water-proof sheets should be fanfolded. In some clinics, the operative site and/or the distal region is enveloped in a muslin slip-on cover, a cotton pillowcase, or a stockinet cover.

For Surgery on the Ankle or Foot

Sterile Items.—A lower extremity pack, including the following:

1 Large towel
1 Sheet, double-thickness or single water-proofed, 72 by 90 inches
2 Sheets, double-thickness or single water-proofed, 90 by 108 inches
1 Piece of double-thickness stockinet, suitable diameter and length, or muslin slip-on cover
6 Towel forceps

assistants should coordinate their activities effectively by using good body mechanics and by having equipment ready.

Steps of the Procedure.—The duties of the operating team include the following:

The circulating assistant supports the affected extremity, using a sterile towel against the cleansed skin area. When a bone is fragmented, an assistant physician usually applies traction manually to the extremity so that the sharp fragments of bone will not pierce the skin and the surrounding blood vessels and nerves.

If the extremity is encased in a sterile cover, the circulating nurse turns the upper end backward, places her fingers under the protective cuff, and gently removes the cover, keeping its outer surface away from the prepared skin area. The extremity is supported.

The operator, who has scrubbed, places a sterile sheet or towel on the operating table beneath the affected skin area (Chapter 3). The skin area is cleansed and painted. Care is taken to prevent a germicide from entering an open wound, since it would cause further tissue injury. The patient's face should be turned away from the affected site so that the chemical agent will not enter his eyes. In operations on the temporomandibular joint, a small piece of sterile cotton should be inserted in the cleansed external auditory meatus.

To support an extremity, the circulating assistant should always face the operator who is preparing the skin area. For example, in the preparation of a hand, the patient's arm is grasped above the elbow. When the region above the elbow is to be prepared, the hand is grasped and the shoulder is elevated slightly. For operations on the shoulder, the forearm is grasped. When a foot or ankle is to be prepared, the assistant elevates the leg by placing his hand beneath the patient's knee joint.

When the operative site on a male patient involves the pubic region, the lower lumbar spine, or the upper third of the thighs, the genitals are displaced away from the proposed operative site and covered with a small sterile towel, which is held in place with adhesive tape. In a female patient, the vaginal region is covered with a small towel, which is placed longitudinally and secured by adhesive strips.

LACERATED WOUNDS

The areas are cleansed as soon as possible to remove gross dirt and pathogenic organisms. The devitalized tissues are removed, as they are suitable media for bacteria.

The Sterile Setup.—The items include the following:

1 Irrigating set
1 Asepto syringe
2 Medication cups
1 Metal basin
1 Soft hand brush
1 Orangewood stick
12 Gauze compresses
2 Sponge-holding forceps
2 Tissue forceps with 1 and 2 teeth
12 Compressed paper sponges

Steps of Procedure.—

1. To support the affected leg and prevent it from dangling, an assistant, standing with his back toward the head of the table, and with arms extended, holds the leg just below the knee, using a sterile folded towel.[4]

2. A gowned and gloved operator places a foundation sheet across the lower half of the table and the unaffected leg up to the thigh. He then places a towel transversely across the draped part of the table so that the towel's distal edge is at a level with the lower third of the affected leg (Fig. 497,*A*).

3. The assistant supporting the leg or foot places it on the towel. The operator folds the sides of the towel snugly across the leg and fastens the towel in place with the towel forceps clipped to towel and skin (Fig. 497,*B*).

4. As the assistant elevates the leg the operator places a medium sheet transversely on the lower end of the table so that the top fold is at a level with the lower end of the towel secured around the leg. The leg is then placed on the draped table (Fig. 497,*C*).

5. The operator drapes a large sheet over the patient by placing the lower end at a level with the top edge of the sheet on the table, bringing the remaining folds of the sheet over the patient and the anesthetist's screen and fastening with towel forceps (Fig. 497,*C*). The bottom fold of the top sheet is clipped to the top fold of the lower sheet on each side of the ankle. This step prevents exposure of an "unclean" area as the leg is manipulated during the operation.

6. In some cases the prepared operative site may be encased in a muslin cover or stockinet. When used, the cover is usually slipped over the foot and ankle before the bottom sheet is draped over the operating table, and the edges of the cover are secured to the sheets with the towel forceps (Fig. 498).

For Surgery on the Knee and Mid-Thigh

Sterile Items.—A lower extremity pack, plus the following:

Gauze
1 Bandage
1 Regular sheet
1 Stockinet or muslin slip-on cover
1 Regular or fenestrated sheet

Steps of Procedure.—

1. *Placement of the Foundation Sheets.*—The assistant operator elevates and supports the affected leg as the operator places a large sheet across the lower half of the table and unaffected leg. The sheet should begin at a level with the gluteal fold and extend over the foot of the table. To provide adequate protection above and below the proposed operative site, the operator takes a surgical towel and places it on the draped portion of the operating table, transversely at a level with the mid-thigh. He then takes a second towel and releases the lower half onto the sheet over the foot of the operating table. The assistant places the affected leg in the center of these towels. The operator brings the remaining part of the towel in his hand over the leg, folds the sides of the towel across it, and fastens the towel in place with towel forceps

(Continued on page 748)

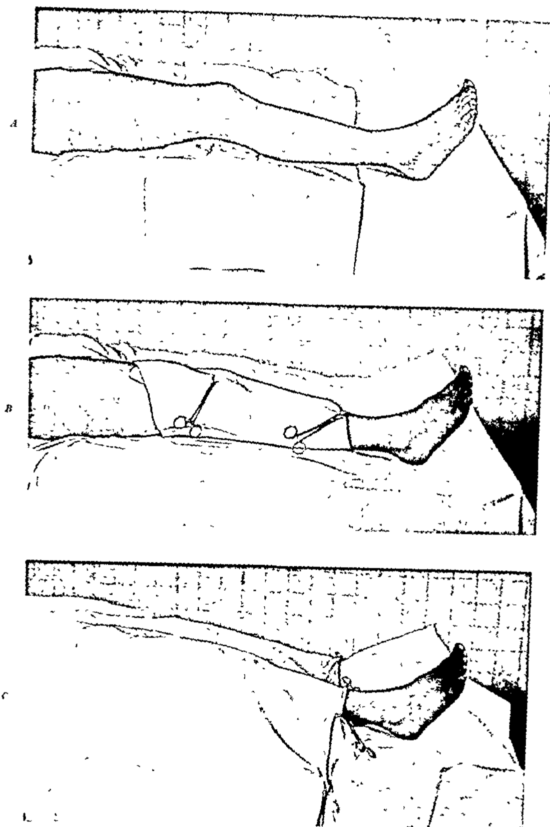


Fig 497 —*A*, In preparing the foot and ankle for surgery, the skin is cleansed from the toes to just below the knee The foundation sheet and towel are shown in place under the extremity *B*, The cleansed leg is wrapped in a sterile towel which is secured to the skin by towel forceps *C*, The top and bottom sheets are fastened together at each side of the extremity with towel forceps (From Speed, J S, and Knight, R A Campbell's Operative Orthopaedics, St. Louis, 1956. The C V Mosby Co)



Fig 499.—Draping of leg Worker does not touch inner side of sterile sheet or cleansed skin surface when bringing lower portion of sheet over the foot and lower leg.

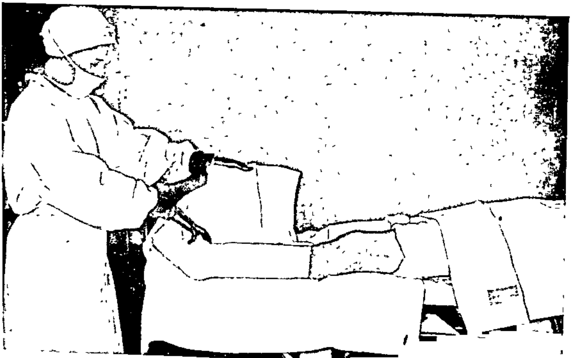
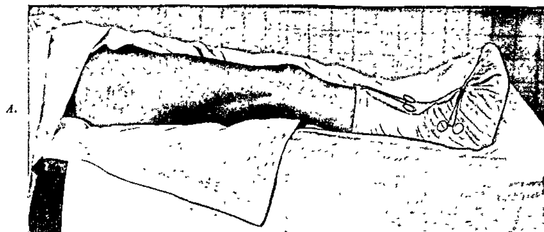


Fig 500—Draping of leg—cont'd The flaps of the sheet are neatly and snugly brought over the foot and lower leg

A.



B



C

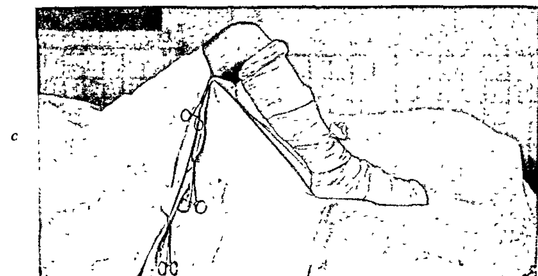


Fig 498 — *A*, Draping of knee Skin prepared from groin to ankle Foot and lower leg en- [illegible] foundation sheets and towel in place *B*, Foot and lower leg enveloped in [illegible] ounds thigh and is fastened in place with towel clips *C*, [illegible] bulky by snug application of sterile roller bandage Drag [illegible] p sheet, thereby permitting wide range of motion of knee [illegible] ield (From Speed, J S, and Knight, R A: *Campbell's* [illegible] 956, The C V Mosby Co)



Fig 503 —Alternate method of fastening large sheets in draping of leg Assistant supports leg as draper secures center portion of upper fold around leg with towel forceps.



Fig 504 —After upper sheet has been draped over the patient, assistant supports leg, as draper secures center portion of lower fold around leg with towel forceps, encasing lower sheet and stockinet, thereby permitting range of motion of knee and hip without exposing unsterile field.

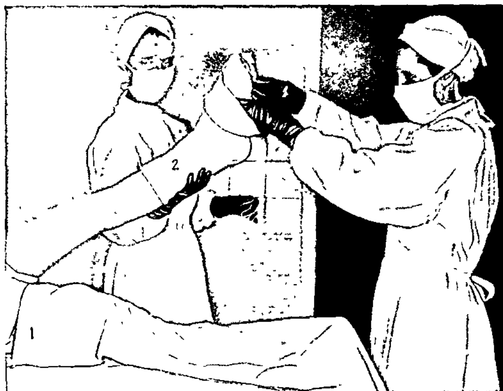


Fig. 501.—Draping of leg—cont'd. One worker, facing the foot of the table, supports the affected lower leg, as a second worker, near the foot of the table, slips the tubular piece of stockinet over the foot

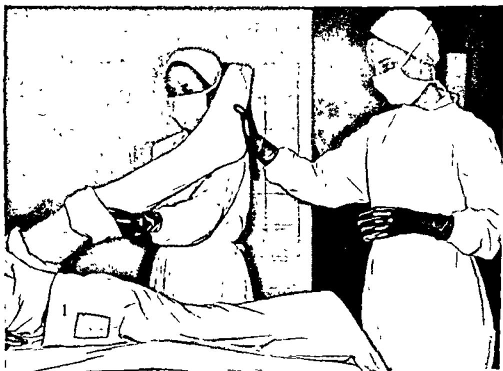


Fig 502.—Draping of leg—cont'd. The assistant, facing foot of table, supports leg as draper brings folds of stockinet over thigh

of the sheet around the mid-thigh. It may or may not be secured with a towel forceps (Figs. 498 and 503).

The operators place a second fanfolded sheet over the patient, keeping the bottom fold at a level with the top fold of the undersheet, and bringing the upper end of the top sheet around the leg and securing the sheet with a towel forceps (Fig. 504). In some cases the operator secures the top fold of the undersheet to the lower fold of the uppermost sheet at several points on each side of the leg.

3. *Placement of the Fenestrated Sheet.*—This type of sheet may be used rather than the regular fanfolded sheets. To apply a fenestrated sheet the assistant supports the affected leg as the operator inserts the covered foot through the opening and unfolds the top section (shorter end) downward over the foot of the table (Fig. 505,*A*). The assistant places the leg on the operating table, and the operator opens the lower section of the sheet (longer end) over the patient and the anesthetist's screen (Fig. 505,*B*,*C*).

For Surgery on the Hip

Sterile Items.—A hip pack, including the following:

- 6 Large towels
- 3 Sheets, fanfolded, 2 large- and 1 medium-sized
- 1 Split sheet, or 2 small sheets
- 2 Pieces of stockinet, suitable size for leg and hip regions, if desired
- 8 Towel forceps

Steps of Procedure.—The method carried out will depend on the position of the patient on the operating table, the location of the operative site, and the type of operation to be performed. For most cases with the patient in a supine position, the steps include the following:

1. *Placement of the Foundation Sheets, Towels, or Stocking.*—These items are applied as described for a leg draping procedure except that a piece of stockinet, towels, or muslin slip-on cover may be used to envelope the limb. The operator slips one wrapper over the affected leg, so that it extends from the lower mid-thigh down to the foot; then he takes an open-ended piece of stockinet and draws it over the upper thigh and buttock and secures the stockinet to the sheets with towel forceps (Fig. 506).

In some cases a small sheet, rather than the stockinet, is used. The operator then places four towels around the proposed site and secures them in place, using towel forceps or sutures of silk.

2. *Placement of the Upper Sheets.*—The operator drapes one large sheet on the table beneath the hip region and brings the upper fold of the sheet around the proposed operative site and the remaining folds downward over the table. The assistant places the leg on the draped operating table. The operator drapes a large sheet across the upper part of the patient and brings the bottom folds of the sheet across the hip region and the remaining folds over the patient and the anesthetist's screen. The operator drapes two small sheets, one on either side of the operative site, and fastens them to the folds of the bottom and top sheets, using six or more towel forceps. (Fig. 507.)

or by applying a bandage. The operator then folds the sides of the other towel across the thigh and secures the towel in place with towel forceps (Fig. 498)

In some situations the assistant supports the leg as the operator first encases the foot and leg in a sheet and secures it in place by applying a bandage which extends from the toes to the proximal end of the cover, and then applies the stockinet or muslin cover (Figs. 499 to 502).

2. *Placement of the Upper Sheets.*—The operators place a large sheet longitudinally on the operating table beneath the entire leg, bringing the top fold

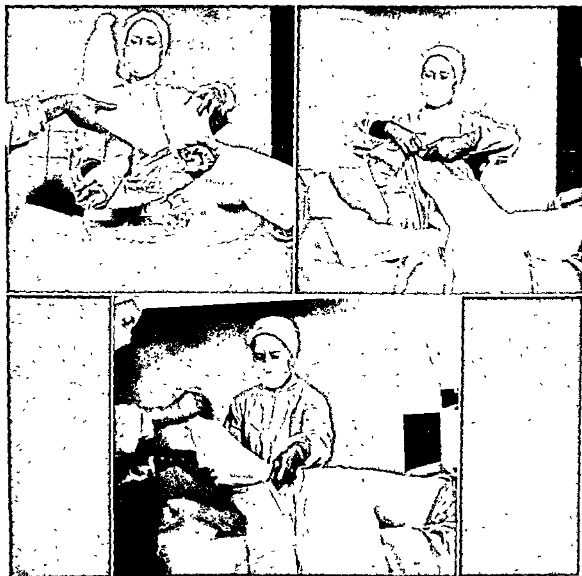


Fig 505—*A*, Draping the leg, using a fenestrated sheet After the foundation sheets are in place, the draper introduces the foot through the opening in the sheet, and drapes the folds of the sheet over the sides of the table *B*, The assistant supports the leg as the draper unfolds the upper section of the fenestrated sheet over the foot of the table, then the assistant places the foot on it. *C*, The draper grasps the sheet beneath its upper fold and keeps her hands under it as she unfolds the sheet over the patient and the anesthetist's screen

of the sheet around the mid-thigh. It may or may not be secured with a towel forceps (Figs. 498 and 503).

The operators place a second fanfolded sheet over the patient, keeping the bottom fold at a level with the top fold of the undersheet, and bringing the upper end of the top sheet around the leg and securing the sheet with a towel forceps (Fig. 504). In some cases the operator secures the top fold of the undersheet to the lower fold of the uppermost sheet at several points on each side of the leg.

3. *Placement of the Fenestrated Sheet.*—This type of sheet may be used rather than the regular fanfolded sheets. To apply a fenestrated sheet the assistant supports the affected leg as the operator inserts the covered foot through the opening and unfolds the top section (shorter end) downward over the foot of the table (Fig. 505,*A*). The assistant places the leg on the operating table, and the operator opens the lower section of the sheet (longer end) over the patient and the anesthetist's screen (Fig. 505,*B*,*C*).

For Surgery on the Hip

Sterile Items.—A hip pack, including the following:

- 6 Large towels
- 3 Sheets, fanfolded, 2 large- and 1 medium-sized
- 1 Split sheet, or 2 small sheets
- 2 Pieces of stockinet, suitable size for leg and hip regions, if desired
- 8 Towel forceps

Steps of Procedure.—The method carried out will depend on the position of the patient on the operating table, the location of the operative site, and the type of operation to be performed. For most cases with the patient in a supine position, the steps include the following:

1. *Placement of the Foundation Sheets, Towels, or Stocking.*—These items are applied as described for a leg draping procedure except that a piece of stockinet, towels, or muslin slip-on cover may be used to envelope the limb. The operator slips one wrapper over the affected leg, so that it extends from the lower mid-thigh down to the foot; then he takes an open-ended piece of stockinet and draws it over the upper thigh and buttock and secures the stockinet to the sheets with towel forceps (Fig. 506).

In some cases a small sheet, rather than the stockinet, is used. The operator then places four towels around the proposed site and secures them in place, using towel forceps or sutures of silk.

2. *Placement of the Upper Sheets.*—The operator drapes one large sheet on the table beneath the hip region and brings the upper fold of the sheet around the proposed operative site and the remaining folds downward over the table. The assistant places the leg on the draped operating table. The operator drapes a large sheet across the upper part of the patient and brings the bottom folds of the sheet across the hip region and the remaining folds over the patient and the anesthetist's screen. The operator drapes two small sheets, one on either side of the operative site, and fastens them to the folds of the bottom and top sheets, using six or more towel forceps. (Fig. 507.)

If a split sheet rather than a regular sheet is used, the operator brings the tails of the split sheet around the prepared hip region and fastens them in place with towel forceps; he then places a small sheet over the patient, as described previously.



Fig 506—Draping the hip Lower extremity from groin to toes encased in sterile towels and sterile slip-on cover; these in turn surrounded by sterile roller bandage. Operative field outlined by four sterile towels held in place with towel forceps through skin at frequent intervals In some hospitals, stockinet, rather than sterile roller bandage, is used and towels are secured with silk sutures rather than towel forceps (From Speed, J S., and Knight, R A: Campbell's Operative Orthopaedics, St Louis, 1956, The C V. Mosby Co)

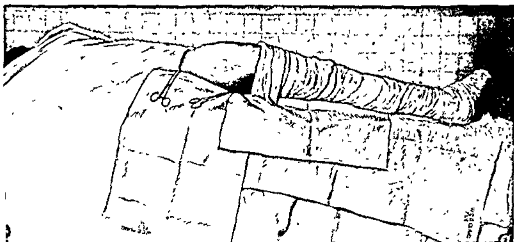


Fig 507.—Interval between top sheet and foundation sheets and towels covered with sterile pillow cases Drag sheet on inner aspect of thigh, in turn attached to sterile pillow cases with towel forceps at frequent intervals, preventing exposure of perineum on abduction of the hip. In some hospitals small double-thickness sheets rather than pillow cases are used (From Speed, J. S, and Knight, R A. Campbell's Operative Orthopaedics, St. Louis, 1956, The C V. Mosby Co)

For Surgery on the Spine

Sterile Items.—The textiles include the following:

1 Celiotomy pack (Chapter 11), or fenestrated split sheet
4 Towels

Steps of Procedure.—The operator drapes the proposed operative site with four surgical towels and secures them in place with sutures; he then opens a fanfolded fenestrated sheet over the patient (Chapter 11).



Fig 508—*A*, Draping forearm and wrist. The armrest is draped with a sterile double-thickness sheet. The draper keeps the hands under the top fold, while unfolding sheet, and brings the upper fold around the lower arm or wrist. *B*, A large sterile sheet has been opened over the patient, extending from his lower chest region and foot of the table. Then a small sheet is draped over the arm, upper chest region, and anesthetist's screen, and the lower fold of the top sheet is fastened over the forearm, at various points, to the top fold of the undersheet on the armboard. *C*, The forceps nearest the wrist are clipped to the stockinet, thereby permitting wide range of motion of the arm and forearm.

For Surgery on an Upper Extremity

Sterile Items.—As for lower extremity.

Steps of Procedure.—The shoulder, elbow, arm, and hand are draped in a way similar to that described for the hip, knee, leg, and foot, respectively.

1. *Placement of Foundation Sheets and Towels.*—When draping a shoulder the assistant stands with his back toward the head of the table, elevates the extremity, using a sterile towel, and raises the shoulder slightly so that the operator can place a small sheet beneath it and the posterior regions of the back and scapula. The operator places a second sheet transversely across the anterior chest and abdominal regions, and then takes a surgical towel and releases the lower portion onto the draped chest region.

The assistant places the patient's hand on the center of the towel. The operator brings the distal end of the towel across the hand and forearm and applies a bandage, extending from the fingers to just beyond the ends of the towel.

2. *Placement of Slip-on Cover and Upper Sheets.*—The operator slips a piece of tubular stockinet over the hand and outer aspects of the shoulder as the assistant supports the arm. The operator makes a few slits in the proximal edge of the stockinet to permit it to fit snugly around the arm.

The remainder of the draping procedure is similar to that described for draping a hip.

Draping procedure for surgery on the elbow is done as described for a shoulder operation, except that the foundation sheet is placed across the chest and beneath the axilla.

Draping procedure for surgery on the hand is similar to that described for a foot operation A sheet is placed on the armrest (Fig. 508). The hand may be enveloped in a stocking or stockinet. The operator places the lower fold of a medium-sized sheet at a level with the prepared wrist, and opens the remaining folds of the sheet over the chest region, allowing the end to fall over the anesthetist's screen The operator then opens a large sheet over the patient and secures the upper end of the bottom sheet on the armrest to the folded edge of the top sheet that covers the hand. The stockinet, if used, is secured to the folds of the sheet at either side of the wrist or forearm.

USE AND APPLICATION OF A TOURNIQUET

A pneumatic tourniquet, such as the Campbell-Boyd or Robbins, or Martin bandages may be applied to an extremity to provide for a bloodless field during surgery on a joint, nerve, or tendon Even though the surgeon applies the tourniquet, the nurse should know why it is a dangerous instrument when it is not used properly or is not in good working order.[4, 18, 22]

A Martin strap tourniquet, if used, is only applied to the middle and upper thirds of a thigh.[4] It is applied after the patient has been anesthetized, because an adductor muscle spasm may cause the tourniquet to leak after the muscles have become relaxed.

Before a tourniquet is applied to the upper region of an arm or thigh, the region should be well padded and elevated for three minutes. The Martin bandage, if used, is applied by beginning at the fingers or toes so that the blood is expressed by the bandage, thereby preventing venous thrombosis.

When a sphygmomanometer or pneumatic tourniquet is to be used, all air is expressed from it and it is applied evenly and smoothly. The pneumatic tourniquet is inflated quickly to prevent filling of the superficial veins before the arterial blood flow is occluded. The degree of pressure to be applied depends on several factors. These include the patient's age, the blood pressure rate, and the size of the extremity. To control bleeding, usually the average adult arm requires a pressure of 300 mm. Hg (almost 6 pounds) and the average thigh about 500 mm. Hg (almost 10 pounds).[4] The period of time a tourniquet can be safely inflated on an extremity also depends on the patient's age and the vascular supply of the extremity. In many clinics the tourniquet is inflated on an arm for about one hour and then released for ten-minute periods before reinflation.

After use, pneumatic tourniquets must be checked for leaking valves and gauges. The casing of the inner tube must be completely intact so that the tube will not protrude through an opening, allowing the pressure to fall. The so-called tourniquet paralysis may result from insufficient or excessive pressure, too long an application, or improper application.

Germicides applied to the operative area must not be allowed to run beneath the tourniquet because a chemical burn may result. To prepare a sterile Martin bandage for use, unroll the bandage, wrap it in a muslin cover, and sterilize it with saturated steam under pressure for 15 minutes at 250° F. In the operating room the bandage is rolled, starting at the taped end.

OPERATIONS

Fractures and Dislocations

A fracture is an injury which includes the breaking of a bone. It is usually very painful and requires immediate treatment. The care of fractured bones or dislocation of a joint is always complicated due to trauma to the soft parts of the body, including the muscles, nerves, and blood vessels.[3-6, 13]

Types

Fractures are classified in two main groups: the nonpenetrating (closed) fractures and penetrating (compounded or open) fractures.[4, 5, 7, 24]

Closed fractures are those in which no wound of the skin communicates with the break in the bone (Figs. 509 and 510). Incomplete fractures are those in which the whole thickness of the bone is not broken but is bent or buckled, as in the so-called greenstick fractures that occur in children before puberty.

Penetrating fractures exist when the break in the bone communicates with a wound in the skin. Since these fractures are contaminated, measures

For Surgery on an Upper Extremity

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are carried out to control potential infection. There are two types of open fractures, direct and indirect. (Figs. 511 and 512.) The direct types are those in which violence opens the fracture from without. Indirect types are those in which the fractured fragments come through the soft tissue from within.

There are many varieties of fracture architectures including (1) the transverse fracture in which the fracture line runs at a right angle to the longitudinal axis of the bone; (2) the comminuted fracture in which the bone

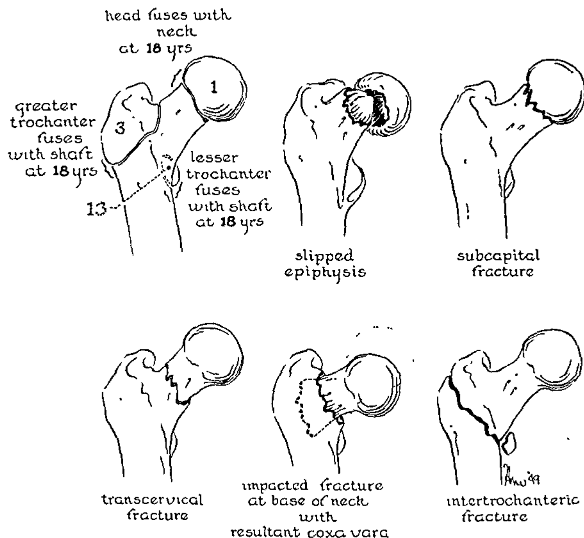


Fig 509 —Ossification, slipped epiphysis, and fractures of the upper end of femur (From Moseley H F. Textbook of Surgery, St Louis, 1952, The C V Mosby Co)

fragments splinter into many pieces, (3) the impacted fracture in which one fragment is driven into the other end and is relatively fixed in that position; (4) the longitudinal fracture which runs along the length of the bone; (5) the oblique fracture; (6) the spiral fracture; and (7) the spontaneous (pathological) fracture that may occur when a bone is weakened by disease, thereby preventing a bone from breaking under trivial violence.

An epiphyseal separation occurs when a fracture passes through or lies within the growing area of a bone (Fig. 509). A sprain fracture results from a joint displacement where the ligament avulses its bony attachment instead of rupturing its fibers. A dislocation is a complete displacement of one articular surface of a joint from the other. A subluxation is a partial dislocation.

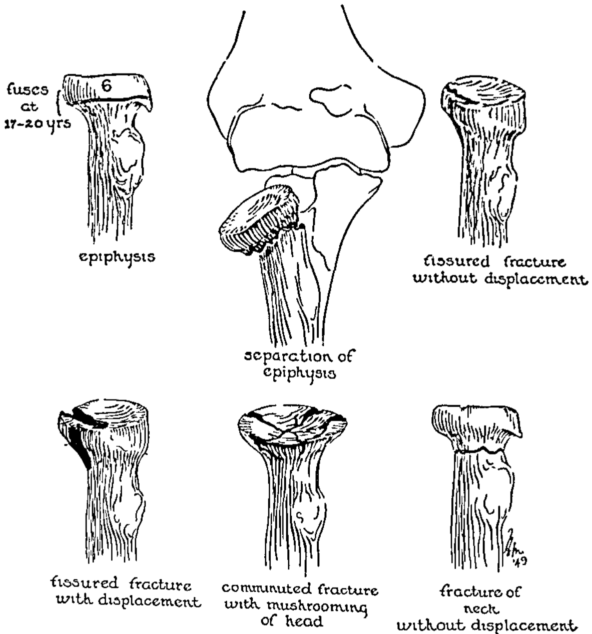


Fig 510 – Types of fractures of head and neck of radius (From Moseley, H F: Textbook of Surgery, St Louis, 1955, The C. V. Mosby Co)

The Bone-Healing Process of Fractures

When a bone is fractured, hemorrhage occurs. The amount of extravasated blood depends on the size and number of the ruptured blood vessels.[5, 7, 8] The blood and inflammatory exudate infiltrate the surrounding area, where

Fig 511 —Injury to shoulder force of transmission of the shoulder in falling *1*, Results in the arm at side, *2*, results with the arm partly abducted, *3*, results with arm abducted and extended (From Bateman, L E The Shoulder and Environs, St Louis, 1956, The C V. Mosby Co)

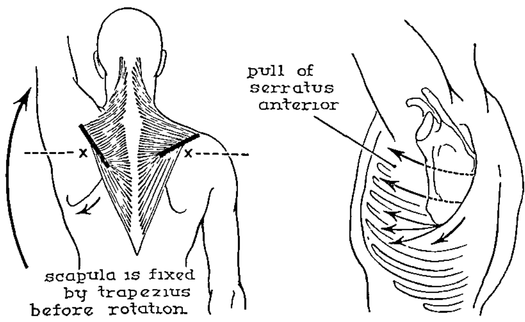


Fig 512—Action of the two important fixators of the scapula Trapezius prevents rotating swing, serratus anterior prevents posterior swinging (From Bateman, L E The Shoulder and Environs, St Louis, 1956, The C V Mosby Co)

they form clots which, in turn, are invaded by the vascular granulation tissue coming from the ends of the fragments.

About the fourth day calcium deposits form in the granulation tissue; this eventually forms new bone known as callus. Within the callus substance cartilage cells form a temporary semirigid tissue which helps to stabilize the healing fractured fragments. New connective tissue cells (osteoblasts) of the periosteum and the medullary cavity invade the callus. Through their influence this substance becomes the mature bone and the excess callus is reabsorbed. This last stage of the healing process takes many months, especially if the patient is past middle age, but the fractured bone usually is firmly united before the ossification process is complete. Sound union is determined by the aid of clinical and radiologic examinations.

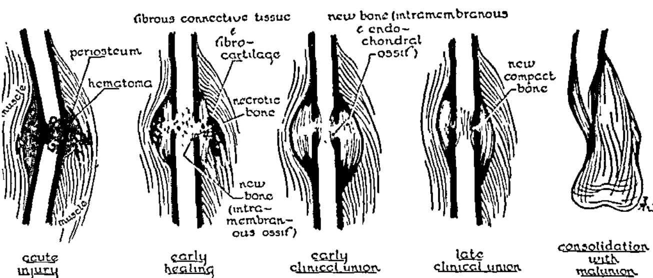


Fig 513—Stages in healing fractures (After Urist; from Moseley, H F. Textbook of Surgery, St. Louis, 1955, The C V Mosby Co)

Delayed union occurs when a fracture is not firmly united after a period of time which seems sufficient for union to have taken place.[28-30] Delayed union takes place in the presence of severe trauma and infection and when the fractured ends of the bone have not been immobilized.

In nonunion of a fractured bone the ends of the fragments may become sclerotic and resistant to nature's own attempt to form another canal across the fracture site.[4, 7, 9] Nonunion may result from interposition of muscles situated between the bone fragments, thereby obstructing normal bone healing. It also results from poor immobilization which permits the fragments to move too freely, thus injuring the blood vessels in the callus. Malunion, meaning the fractured fragments are in poor position, may be due to inaccurate reduction or to inadequate immobilization. In the presence of malunion the patient may acquire certain disabilities, such as a shortening of the extremity due to overriding of the bone fragments, lateral angulation, or rotation[3, 7]

Aims and Principles of Fracture Treatment

Purpose.—The methods of fracture treatment aim to re-establish the length, shape, and alignment of the extremity and to restore the physiologic function of the limb or joint to normal.

Considerations.—The principles of open or closed operations on fractured bones and joints include the following: (1) correcting excessive displacement and holding normal alignment of the bone fragments, (2) immobilizing the fracture to prevent redisplacement of the fragments, (3) providing conditions whereby union can take place, and (4) maintaining functional activity of all tissues and vessels.

In caring for the patient the operating team's activities include using gentleness, providing adequate body support, treating impending or existing shock, controlling hemorrhage, administering antibiotics, antitoxins, and fluids, safeguarding circulation and respiration functions, carrying out aseptic practices during surgery, and relieving the patient's anxiety.

To correct an overgrowth of a long fractured bone in a child, some overriding of displaced fragments is desirable. In the healing phase the growing rate of a long bone is stimulated by the additional blood supply that is furnished directly or indirectly by the fracture.

Since all types of fractures are composed of two parts of bone, the proximal and distal fragments, the position of the proximal fragment (the one closer to the body) is controlled by pulling of the attached muscles. For this reason the distal fragment must be manipulated into the position that is assumed by the proximal fragment. The physician considers this principle as he determines the choice of treatment for the individual patient.

Since the upper extremities have a wide range of motion and are needed to perform skilled and delicate work, surgery is carried out to preserve their mobility. In treating a fracture of a lower limb, surgery aims to restore alignment and length and to provide stability of the limb.

In compound fractures soft tissue complications may be caused by one of several conditions. Secondary hemorrhage may be due to infection, severe debilitation, lack of vitamin C, or late punctures of large blood vessels by motion of short bone fragments. Gas gangrene results from contamination by spore-bearing, gas-producing organisms in the open wound (Chapter 2).

A traumatic arterial spasm may result from a contusion of the main artery to the limb. This condition may be treated by excision of the injured segment and anastomosis of the artery or through bridging the gap by bank vein or arterial graft. When the vein graft operation is done the vein is reversed in direction so that the valves will not interfere with the blood flow. Arterial spasm may be treated by paravertebral blocking of the ganglionic chain with a local anesthetic agent.

Volkmann's ischemic paralysis may develop if tight-fit tissues or tight casts obstruct the venous return. Unrelenting increasing pain in the extremity is an early sign of threatening Volkmann's paralysis Loss of position of the fracture is of much less importance than the hazards of ischemia.

Closed Operations for Fractured Bones

Immobilization by Plaster-of-Paris Cast

Definition.—A form of external mold which puts the fractured extremity at rest by immobilizing the joint at both ends of the fracture in a plaster casing.[4]

Setup.—As described for closed reduction, including the following:

Plaster-of-Paris bandages
Sheet wadding
Padding
Table attachments suitable for the type of cast and size of patient

Types of Casts.—A plaster boot may be used for fractures of the foot or ankle. The cast extends from below the knee to the toes which usually are left exposed so that circulation, sensation, and motion can be checked. The foot should be positioned at a 90 degree angle to the leg to prevent a contracture of the leg and stiffening of the ankle.

A complete (long) leg cast which extends from the upper thigh to the foot is used to treat fractures of the tibia and fibula, and a cylinder cast which extends from the upper thigh to the ankle may be used for fractures of the patella. The peroneal nerve, which is situated in the region just below the fibular head, must be protected with padding, since continued pressure will cause a nerve paralysis and foot drop. A walking cast extends under the sole of the foot, and attached at the base of the cast is a weight-bearing extension consisting of a block of wood or rubber, or metal stirrups with rubber tips.[3, 4, 23, 31, 32]

The various types of spica casts designed for different parts of the body include the following: (1) the single spica, which sometimes is used to treat a fracture of the femur, envelopes the trunk, the affected leg and foot (Fig. 514); (2) the double spica, which may be used to treat a fracture of the femur pelvis, covers the trunk and both thighs down to the knees or below; (3) the shoulder spica, which occasionally is used to treat a fracture of the humerus, extends around the trunk and the affected arm (Fig. 515); (4) the body jacket, which is used to treat dorsal and lumbar fractures, encircles the body but not the extremities (Fig. 516).

Precautions.—To prevent the formulation of skin abrasions or decubitus ulcers the cutaneous tissue which overlies the bony prominences is padded but not excessively since overpadding may result in loss of reduction. To prevent circulatory and respiratory embarrassment a cast is not applied too tightly. During its application the assistant must support the fractured limb by placing his palms, not fingers, against the soft cast.

Operative Procedure.—The major steps of applying a cast include the following:

1. After the patient's skin has been cleansed and dried and skin lotion applied, he is placed in the required position on a fracture table or frame.

2. The affected area is covered with a piece of stockinet, fine mesh shirting, or a lisle hose.

3 The bony prominences are padded slightly to protect them from pressure and to allow for swelling under the cast. Usually sheet wadding is bandaged smoothly over the affected extremity.

4. The assistant immerses a plaster bandage in a pail of water, and after the air bubbles cease to rise, grasps the bandage roll at its ends to prevent loss of plaster. He removes it from the water, squeezes out the excess water, unwinds a few inches of the bandage, and then hands it to the surgeon. The plaster bandages must not be oversoaked.

5. The bandages are rolled onto the patient's body without pulling, stretching, or turning them on themselves. In some cases plaster splints are placed over those areas where additional support is needed and are incorporated in the cast by the plaster bandages.

6. The edges of the cast are trimmed. If stockinet has been used, its edges are turned back and anchored with a plaster bandage or tiny pebbles of adhesive tape placed over the outer edges of the cast.

7. Following the application of a circular plaster to a freshly injured extremity, or after open surgery, the cast is split so that it can be opened if circulation becomes impaired. A shrinker type bandage is shown in Fig. 517.

8. The patient is transferred to his bed, and the cast or splint may be dried with an electric fan or left exposed to the air.



Fig 514—Abduction plaster cast for dislocation of the hip (From Richards, V.: Surgery for General Practice, St Louis, 1956, The C V Mosby Co)



Fig. 515.—Plaster-of-Paris cast for immobilization of shoulder and shaft of humerus. *A*, Cast extends to iliac crest. *B*, Cast extends to lower margin of thorax and is suspended from opposite shoulder by a band of plaster (From Speed, J S, and Knight, R. A.: Campbell's Operative Orthopaedics, St Louis, 1956, The C. V. Mosby Co)



Fig 516—Cast for support of upper dorsal or cervical spine, extends from chin and occiput to below crest of ilia Cast must be well padded over bony prominences (From Speed, J. S, and Knight, R A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V. Mosby Co.)

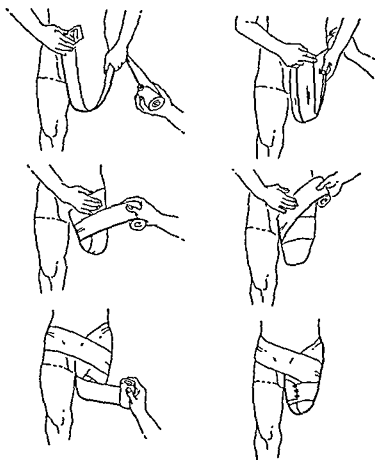


Fig 517.—Method of applying shrinker bandage Most pressure at distal end, minimum at proximal end No circular pressure, all diagonal. To effectively maintain position, two or three spica turns around the torso are essential. Replace at least once every day. (From Syllabus, Prosthesis Education Program, University of California, Los Angeles; in Compere, C L, and Thompson, R G S. Clin. North America, Feb, 1957)

External Fixation of Fractured Bones

Definition.—Fixation of bone fragments by means of metal pins or wires, which are passed through the skin and soft tissue at two points and into the bone, or which may be incorporated in the cast.

Considerations.—An external fixation method is used when a fracture is mechanically unstable, such as in complicated fractures of the wrist and oblique fractures of the forearm or leg, or when powerful muscles prevent reduction of the fragment, such as in a fractured shaft of the femur.[4, 7, 8, 20-23, 33-36]

The advantages of external fixation methods are (1) the healing process is better protected; (2) a plaster cast and traction can be applied, with or without countertraction; and (3) the traction helps to maintain the position of bone fragments and provides a means for applying weights.

There is the danger of wound infection which might result in permanent stiffness of a joint, or chronic osteomyelitis. External fixation methods usually are considered unsuitable to children or if the methods include transfixion of the epiphysis.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for external fixation. The patient is placed on the operating table in a supine position. In some cases the operation may be done while the patient is in his bed. The skin area is cleansed and the patient draped with sterile sheets.

Operative Procedure.—The most common sites for external fixation with wires or pins are the olecranon of the elbow, the calcaneus, heel, lower tibia, tibial tubercle, distal portion of the femur, and the metacarpals.[6, 21] When external traction is to be applied to the skull, Crutchfield tongs or other modifications or hooks are used to grip the outer table of bone.[9, 20] In general, the steps of external fixation include the following:

1. The affected skin area is cleansed with an antiseptic solution. The operator carries out a surgical scrub and puts on a sterile gown and gloves. The patient is draped with sterile sheets.

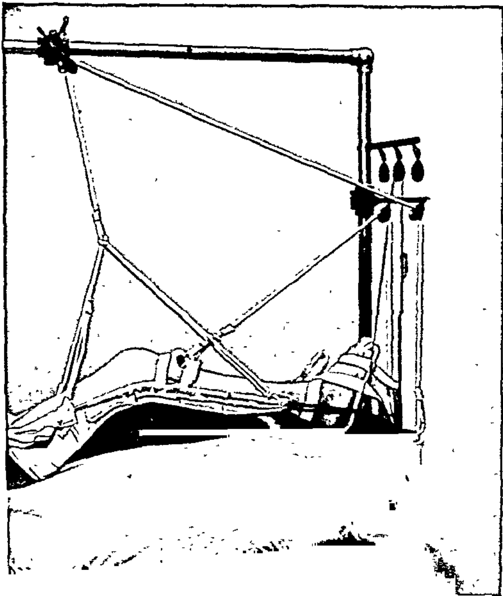


Fig 518.—Hodgen splint rigged for skeletal traction. (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V. Mosby Co.)

2. A small skin incision is made over the points at which the pins or wires are to be inserted.

3. By means of a drill the wires or pins are passed through the skin, soft tissues, and bone.

4. The skin wounds are dressed with cotton or fine mesh gauze.

5. Traction is applied to the wires or pins (Fig. 518). If Kirschner wires are used a washer and screw are placed near the wounds over each protruding end of the wires. The wire ends are cut and corks are placed over them The traction appliance is tightened and adjusted.

6. A plaster mold may be applied to the extremity.

7. The patient is made comfortable in his bed.

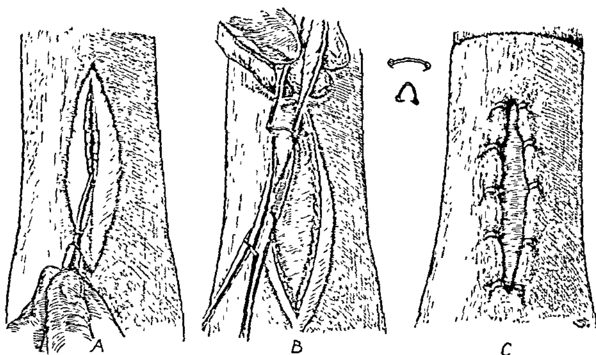


Fig 519.—Draping of edges of skin incision *A*, Sterile stockinet incised in line of skin incision *B* and *C* Stockinet overlaps edges of incision and is held in place by skin clips (From Speed, J S, and Knight, R A Campbell's Operative Orthopaedics, St Louis, 1956, The C V. Mosby Co.)

Open Reduction of Fractured Bones

Internal Fixation of Fractured Bones

Definition.—Through an open wound the fractured site is exposed and the fragments are fixed by means of pins, nails, screws, or plates and screws. A blind method of fixation may be used by applying a short nail (Smith-Petersen) or a long nail (Küntscher or Lottes) through the bone without opening the fracture site.[3, 4, 12, 35-38]

Considerations.—Internal fixation is used when a satisfactory closed reduction cannot be obtained or maintained, or when soft parts are situated between the fractured fragments. Whenever possible, this operation is done before swelling has occurred or after swelling has subsided. It is not done in the presence of an infection.

Setup, Position, Skin Preparation, and Draping Procedure.—Basic setup for internal fixation, plus intramedullary nailing or plating instruments as requested. The patient is placed on the operating table in a supine position and the affected extremity supported. Routine skin cleansing and draping procedure are carried out as described previously.

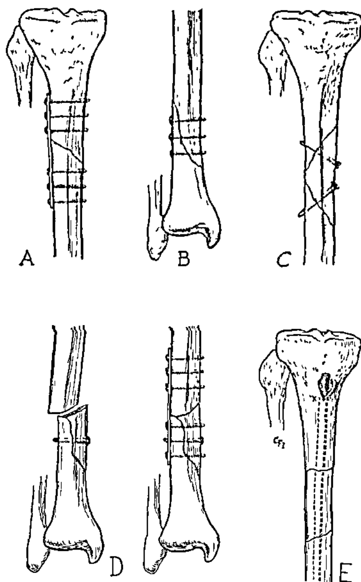


Fig. 520—Techniques of internal fixation *A*, Plate and six screws for transverse or short oblique fracture *B*, Transfixion screws for long oblique or spiral fractures *C*, Transfixion screws for long butterfly fragment *D*, Fixation of fracture with short butterfly fragment. *E*, Medullary fixation (From Speed, J S, and Knight, R A: Campbell's Operative Orthopaedics, St Louis, 1956, The C V Mosby Co)

Fig 521.—Internal fixation of fracture with Eggers plate and screws The screws must be snugly sealed in the bone and must engage both cortices. (From Speed, J S, and Knight, R A.: Campbell's Operative Orthopaedics, St Louis, 1956, The C. V Mosby Co)

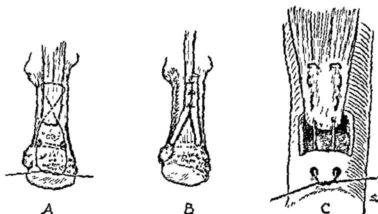


Fig 522.—Fixation of tendon to bone (From Speed, J S, and Knight, R. A: Campbell's Operative Orthopaedics, St Louis, 1956, The C V. Mosby Co)

Operative Procedure.—The major steps of internal fixation, as shown in Figs. 519 to 522, regardless of the location, include the following:

Steps	*Items*
1. The stockinet, if used, is cut to expose the proposed incisional site (Fig. 519). The skin and subcutaneous tissue are incised. To prevent wound contamination the skin edges are protected with towels or gauze pads which are secured in place with sutures or metal clips.	1. Heavy suture scissors, 2 towels or pads, scalpel, scissors, tissue forceps with teeth, silk or cotton No. 3-0 on skin needles, 2 needle holders or skin clips on holders, gauze sponges, basin for skin instruments, surgical towel
2. The muscles are separated and retracted, the periosteum is divided and elevated, the scar and granulation tissues are removed, and the bone ends are grasped and approximated.	2. Scissors, suitable retractors (Roux, Hibbs, or Bennett type), scalpel, scissors, tissue forceps, periosteal elevators, sharp and blunt, straight and curved types, bone-holding forceps
3. The fractured fragments are fixed by means of a plate and screws, or by screws alone. For the best tightening effect the drill should be approximately of the same diameter as the screws to prepare the proximal cortex, and the drill for the distal cortex should be slightly smaller. Holes are drilled in the bone in this fashion; then the screws are inserted.	3. Desired type and size of plates and screws, screw driver, screw measure and guide, screw holder, sponges, Asepto syringe filled with normal saline solution, basin, drill, electric type if desired, and drill points of correct size

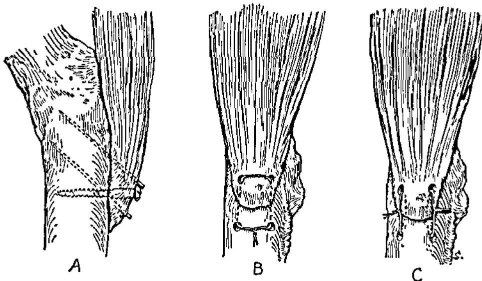


Fig 523—Fixation of osseous attachment of tendon to bone. *A*, Fixation by vitallium screw or nail. *B*, Fixation by mattress suture of stainless steel wire through holes drilled in bone. *C*, Fixation by wire loops (From Speed, J. S., and Knight, R A: Campbell's Operative Orthopaedics, St Louis, 1956, The C. V. Mosby Co)

Steps	*Items*
In a few cases, sutures may be used by passing them through the drilled holes in each fragment and tying the ends over the fragments	Stainless steel or heavy silk sutures (Fig. 522)
4. The periosteum, muscle, and fascia are closed. The skin towels or pads are removed, and the wound edges protected by towels. The subcutaneous tissue is approximated, the skin edges are sutured together, and dressings are applied to the wound. A plaster-of-Paris casing is applied. The patient is transferred to his bed or recovery room stretcher and the affected extremity supported.	4. Chromic gut or silk sutures on ½-circle trocar-point needles, needle holders, tissue forceps with teeth, basin for discarded instruments, fresh towels, fine chromic gut or silk sutures on ½-circle taper-point needles, needle holder, silk or stainless steel skin sutures, plaster casing setup, dressings, and supports.

Bone Grafting of Fractured Bone

Definition.—Exposure of the fractured fragments, attachment of healthy bone onto the bone fragments, and insertion of screws through holes made in the graft and into the cortex of the fragments

Considerations.—The type of graft to be done generally depends on the location of the nonunited bone, the condition of the ends of the fragments, and the preference of the surgeon.[4, 29, 30, 31] An autogenous graft may be taken from the tibia, ilium, or fibula; or a homogeneous graft may be obtained from the bone bank or a donor. The donor and patient need not have the same Rh or blood type.

A massive onlay graft may be taken from the tibia, including the periosteum and the full thickness of the cortex (Fig. 521). However, this extensive borrowing from the tibia is a hazardous procedure and may be followed by infection or may cause immediate or late fatigue type fracture at the donor site. A cancellous graft comprising the spongy bone of the ilium may be used as a nonrigid graft. Intramedullary peg grafts are sometimes used for fixation of a fractured femur, humerus, radius, or ulna, but bone grafts alone become poor fixation aids because they are absorbable

Purpose.—When there is sclerosis of the bone ends with nonunion, a bone graft is used to stimulate osteogenesis in each fragment.

Setup, Position, Skin Preparation, and Draping Procedure.—As for internal fixation, including plating and bone grafting Instruments as listed previously. Two sterile instrument setups and other, unsterile equipment, such as two instrument tables and two Mayo stands, are needed. One setup is used to obtain the graft and the other is used to fix the graft to the bone fragments. The graft site and the fractured extremity are usually draped separately.

Operative Procedure.—The steps carried out to obtain and apply a bone graft include the following.

1 The patient is prepared as described for internal fixation.

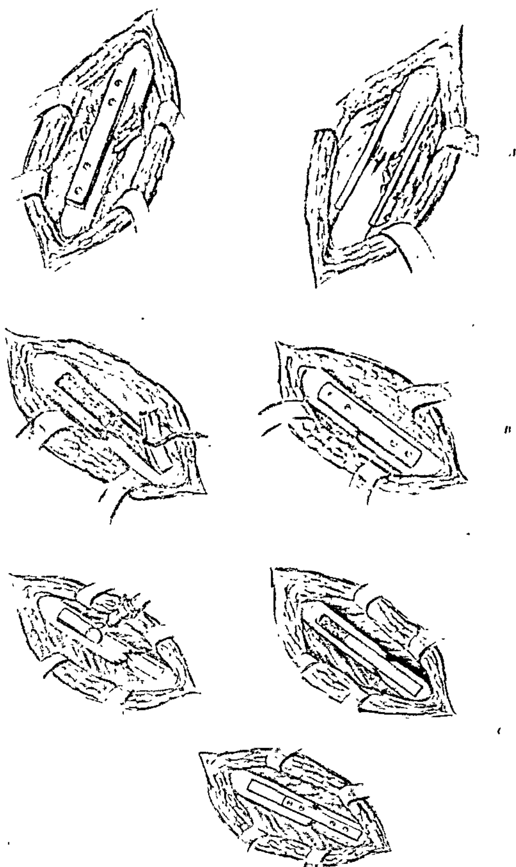


Fig 524—*A*, Onlay bone graft *B*, Inlay bone graft, *C*, Sliding inlay graft. (From Shafer, S J: S Clin. North America, Feb, 1957)

Steps	*Items*
In a few cases, sutures may be used by passing them through the drilled holes in each fragment and tying the ends over the fragments.	Stainless steel or heavy silk sutures (Fig. 522)
4. The periosteum, muscle, and fascia are closed. The skin towels or pads are removed, and the wound edges protected by towels. The subcutaneous tissue is approximated, the skin edges are sutured together, and dressings are applied to the wound. A plaster-of-Paris casing is applied. The patient is transferred to his bed or recovery room stretcher and the affected extremity supported.	4. Chromic gut or silk sutures on ½-circle trocar-point needles, needle holders, tissue forceps with teeth, basin for discarded instruments, fresh towels, fine chromic gut or silk sutures on ½-circle taper-point needles, needle holder, silk or stainless steel skin sutures, plaster casing setup, dressings, and supports.

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Definition.—Exposure of the fractured fragments, attachment of healthy bone onto the bone fragments, and insertion of screws through holes made in the graft and into the cortex of the fragments.

Considerations.—The type of graft to be done generally depends on the location of the nonunited bone, the condition of the ends of the fragments, and the preference of the surgeon.[4, 23, 30, 34] An autogenous graft may be taken from the tibia, ilium, or fibula, or a homogeneous graft may be obtained from the bone bank or a donor. The donor and patient need not have the same Rh or blood type.

A massive onlay graft may be taken from the tibia, including the periosteum and the full thickness of the cortex (Fig. 524). However, this extensive borrowing from the tibia is a hazardous procedure and may be followed by infection or may cause immediate or late fatigue type fracture at the donor site. A cancellous graft comprising the spongy bone of the ilium may be used as a nonrigid graft Intramedullary peg grafts are sometimes used for fixation of a fractured femur, humerus, radius, or ulna, but bone grafts alone become poor fixation aids because they are absorbable.

Purpose.—When there is sclerosis of the bone ends with nonunion, a bone graft is used to stimulate osteogenesis in each fragment.

Setup, Position, Skin Preparation, and Draping Procedure.—As for internal fixation, including plating and bone grafting. Instruments as listed previously. Two sterile instrument setups and other, unsterile equipment, such as two instrument tables and two Mayo stands, are needed. One setup is used to obtain the graft and the other is used to fix the graft to the bone fragments. The graft site and the fractured extremity are usually draped separately.

Operative Procedure.—The steps carried out to obtain and apply a bone graft include the following:

1. The patient is prepared as described for internal fixation.

way and the patient falls to the floor. After the injury the leg becomes externally rotated if the fracture is not impacted.

The patient with a subcapital fracture is treated by the insertion of a Smith-Petersen nail at the earliest time his general condition permits. If the fracture is close to the femoral head, internal fixation may be supplemented by means of a bone-grafting operation, or an osteotomy of the upper shelf may be done to turn the fracture into a more stable position.

Delay or nonunion may occur in subcapital fractures, especially in those where the fracture line is unstable. The strong pull of the hip muscles often tends to produce a loss of normal angulation between the shaft and femoral neck, resulting in shortening, external rotation, and adduction deformities.

Transcervical (intracapsular) fracture occurs in the midportion of the femoral neck. Occasionally when a femoral neck fracture is impacted in abduction, it may be treated by placing the patient in a plaster spica for several months, but internal fixation is usually needed.

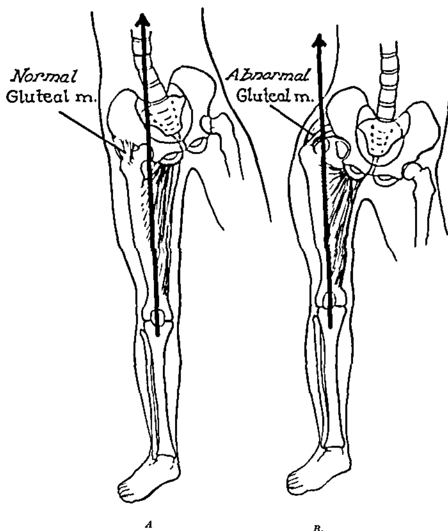


Fig 525 —Gluteal muscles stabilize pelvis *A*, Normal function. On unilateral weight-bearing, center of gravity of body moves over that of leg *B*, Abnormal function from fracture of femoral neck On unilateral weight-bearing, pelvis tilts and trunk lists to compensate and maintain center of gravity of trunk over weight-bearing line (From Richards, V.: Surgery for General Practice, St Louis, 1956, The C V Mosby Co)

2. The skin overlying the fractured bone is incised and the scar tissue is excised as in open reduction. To encourage healing the sclerosed bone may be drilled or removed to stimulate granulation tissue foundation.

3. The graft is obtained and the affected fragments prepared to suit the graft. To form a bed for an onlay graft the periosteum and a portion of the outer cortex are removed from the fragmented ends of the bone. To perform an *inlay or sliding graft a special slot is made in the bone fragments for the reception* of the graft. (Fig. 524.) Occasionally a sliding graft is used for tibial fractures. The graft is cut from the proximal fragment of the fractured bone and slid into the prepared bed over the distal fragment of the bone.

4. To obtain an inlay graft from the tibia a curved incision is made along the anteromedial surface of the tibia, with its convexity to the medial side. The *periosteum is incised and reflected with an osteotome. The size and* shape of the graft are outlined with drill holes, and the graft is removed with an electric oscillating bone saw which has a double blade. A fracture of the entire thickness of the donor bone may occur if the osteotomy is not outlined by drill holes.

5. In an onlay grafting operation bone-holding forceps or Parham bands are used on the operative site as the drill holes are placed through both the graft and the recipient. Screws are then inserted through the holes of the graft and into the cortex of the bone's fragments. In some cases bone chips are laid over the fragments to be united.

6. The wounds are closed in layers and dressings applied. A plaster casing may be applied to the fractured extremity.

Operations on Fractured Hips

Definition of Terms.—Fractures of the upper end of the femur are classified under three main groups: (1) the intracapsular types, which include the capital, subcapital, and transcervical fractures; (2) the extracapsular types, which include the intertrochanter fractures; and (3) the upper femoral epiphysis separation, which is a subcapital injury that usually occurs in prepubertal obese boys (Figs 509 and 525)[3-5, 39 42]

The term intracapsular refers to the inside of the hip joint, and extracapsular, to the outside of the hip joint (Figs. 471 and 472). It is now believed that the time required for union to occur may increase the nearer the fracture line is to the femoral head. This happens because of the difficulty in obtaining good reduction or adequate fixation, and because of poor circulation. The latter factor is evident because circulation to the head of the femur generally comes through the capsule from below upward in the capsular vessels along the neck

Considerations.—A *subcapital* fracture is one which occurs in the upper end of the femur, that is, within the hip joint. Older people usually are the sufferers because of the predisposing factor of bone atrophy in the femoral neck. A subcapital fracture, which may be impacted or grossly displaced, is due to indirect violence, such as slipping on a rug or polished floor. The bone gives

An *intertrochanteric* fracture is located farther from the region of the trochanter and may occur when the person falls directly on the trochanteric region or when his leg is twisted. After the injury the fracture generally shows a full external rotation deformity. The fracture lines of intertrochanteric fractures usually run in different directions, but they generally heal.[4, 10]

Reduction of intertrochanteric fractures may be maintained by plastic hip spica, external fixation and traction, or open operation. The latter includes the insertion of an intermedullary pin or nail into the neck of the femur and the attachment of a plate and screws, such as a Jewett nail and plate, Smith-Petersen nail with McLaughlin plate, or a Neufeld angled nail and plate, to the *outer side of the femur. The advantage of the McLaughlin cannulated nail* and plate is that the desired angle can be adjusted after the nail has been inserted.

A *separation or slipping of the upper femoral epiphysis* (adolescent coxa vara) may occur quickly or gradually. This condition causes a decrease of the angle between the femoral neck and shaft. When this occurs the femoral head rotates posteriorly and inferiorly, and the femoral shaft and neck move forward. It is thought that this lesion is caused by an endocrine condition associated with obesity. It usually is seen in obese children between the ages of 10 and 16, or following a traumatic injury.[35] Acute displacement or a chronic disability in the hip is usually accompanied by a limp.[8]

An acute displacement of the upper femoral epiphysis is treated by manipulative reduction and introduction of a noncannulated, stainless steel, small caliber Smith-Petersen nail, or by manipulative reduction and immobilization with a plaster spica.[4, 21] When a chronic condition exists and is accompanied by gross displacement, a corrective wedge of bone is taken from the femoral neck and a nail inserted.

Femoral Neck Fracture

Definition.—Through an open wound reduction of the fracture, insertion of a metal appliance into the bone fragments, and verification of its position by x-ray pictures.

Setup, Position, Skin Preparation, and Draping Procedure.—Setups include open reduction of an extremity and internal fixation of the femoral neck. The patient is placed on the fracture table in a supine position. The muscles, nerves, and vessels are protected from strain and pressure (Chapter 4). The fracture is reduced by manual traction and rotation of the extremity. X-ray pictures are taken to verify the position of the fractured bone. The operation is not started until the anteroposterior and lateral x-ray pictures show good alignment of the fractured bone. The operating team should carry out safety measures to protect themselves and the patient from x-ray radiation (Chapter 2). The affected skin area is cleansed, and the patient is draped with sterile sheets and fenestrated sheet. (Figs. 12, 506, 507) A sterile x-ray marker is placed on the skin where the appliance is to be inserted.

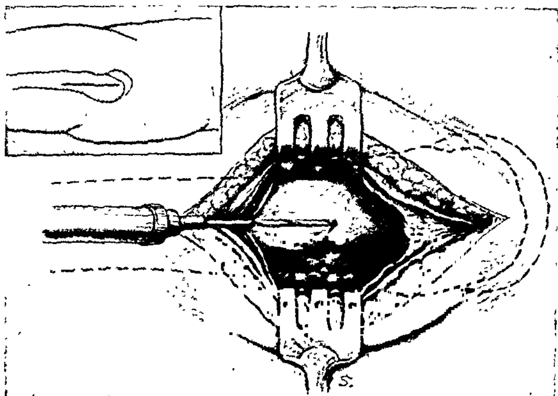


Fig 526 — Insertion of Smith-Petersen nail by blind method. Inset: Line of incision over *trochanter and upper portion of the shaft* *Drill hole through femur ¾ inch distal to trochanter* or vastus lateralis line in anticipated direction of guide pin (From Speed, J S, and Knight, R A. Campbell's Operative Orthopaedics, St Louis, 1956, The C. V. Mosby Co)

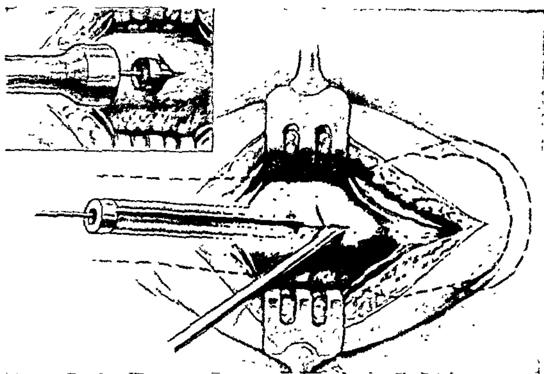


Fig 527 — Insertion of Smith Petersen nail by blind method—cont'd Guide has been inserted to within ¼ inch of articular surface of head of femur and checked by rotengenograms in both lateral and anteroposterior planes, then small cuts are made with chisel to expedite insertion of nail through outer cortex Nail of proper length inserted over guide pin and driven into position with special driver (From Speed, J S, and Knight, R A.: Campbell's Operative *Orthopaedics, St. Louis, 1956, The C V Mosby Co)*

Fig 530 – Special instruments for fixation of trochanteric fractures: Moore blade plate and inserter, Neufeld nail and inserter, Jewett nail and impacter, drill and guide pin, drill and cannulated reamer, Blount anvil retractor, guide and extractor for Jewett nail. (From Speed, J S, and Knight, R A: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V Mosby Co.)



Fig 531 – Instruments for insertion and removal of Kuntscher nails. (From Smith, H: Radiology 61:194, 1953.)

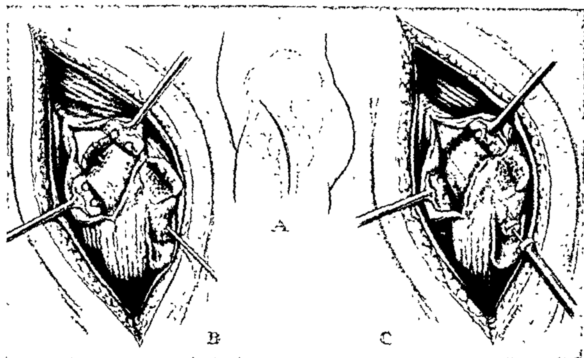


Fig. 528.—Open method of insertion of Smith-Petersen nail, Watson-Jones technique. *A*, Watson-Jones incision. *B*, Exposure of fracture site and insertion of guide pin through promixal fragment to center of fractured surface. *C*, Reduction completed; guide wire inserted into proximal fragment, nail inserted over wire (From Speed, J S, and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V. Mosby Co)

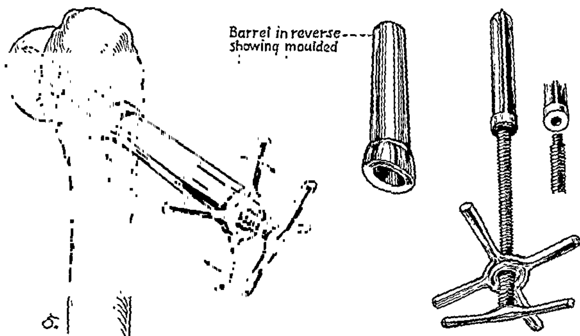


Fig. 529.—Special extractor for removal of Smith-Petersen nail (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V Mosby Co)

Fig. 530.—Special instruments for fixation of trochanteric fractures: Moore blade plate and inserter, Neufeld nail and inserter, Jewett nail and impacter, drill and guide pin, drill and cannulated reamer, Blount anvil retractor, guide and extractor for Jewett nail. (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V. Mosby Co.)

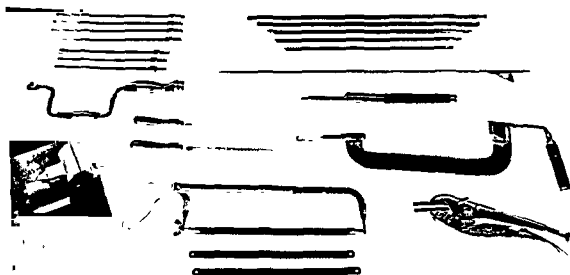


Fig. 531.—Instruments for insertion and removal of Küntscher nails. (From Smith, H.: Radiology 61:194, 1953)

Operative Procedure.—

Steps	*Items*
1. A lateral skin incision about 4 inches long is made over the greater trochanter. The bleeding vessels are clamped and ligated, the wound skin edges protected with skin towels, and the skin instruments discarded.	1. As described for open reduction
2. The fascia and muscle layers are divided and retracted to expose the lateral surface of the trochanter and femoral shaft.	2. Scalpel, tissue forceps, hemostats, curved scissors, Smith-Petersen or Hibbs retractors, sponges
3. A Smith-Petersen guide wire is first inserted into the lateral aspect of the femur; then it is passed through the femoral neck into the femoral head. The position of the wire is verified by x-ray pictures. The length of the nail to be used is determined by measuring the exposed guide wires against another one of the same length.	3 A Smith-Petersen guide or a modification, pins, introductor, or Kirschner wire and drill, if desired (Figs. 526 and 527)
4. The cortex is completely grooved through to the medullary canal by drill holes, or with the aid of a hammer the nail is inserted over the guide wire to fix the fractured fragments. When a nail of sufficient length is not available, two or more threaded Moore pins may be used.	4. Starter, cannulated nail which has been selected for its length, or Moore pin setup, hammer, drill and drill points, if desired
5. The anteroposterior and lateral x-ray pictures are taken to confirm the position of the nail.	5. The patient is covered with a sterile sheet to prevent the field from being contaminated, the operating team make sure safety measures have been carried out against possible explosion and radiation hazards
6. The wound is closed in layers and dressings are applied.	6. As described for open reduction

Intertrochanteric Fracture

Definition.—Through an open wound the fragments are fixed by a metal appliance such as a Jewett angled nail, a Smith-Petersen nail with a McLaughlin plate, a Neufeld nail, a Blount-Moore blade plate and screws, or a Lorenz screw nail and plate.[4, 35, 39, 40, 42]

Consideration.—If fixation of intertrochanteric fractures with a nail alone, angulation and coxa vara will occur because the upper portion of the nail as it lies in the thin lateral cortex of the femur will cut through this inadequate support.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup listed for fixation of intertrochanteric fractures, plus the preferred metal appliances, screws, and screw drivers. The patient is placed in a supine position on the fracture table. The hip region is cleansed as described previously. In some cases the entire affected extremity, the abdomen, and the anterolateral portion of the chest are cleansed. The patient is draped, using a fenestrated hip sheet and regular sheets (Figs. 505 to 507).

Operative Procedure.—The major steps include the following:

Steps	*Items*
1. A skin incision is made in the thigh, beginning at the level of superior aspect of the greater trochanter and extending along the shaft of the femur. Bleeding is controlled and the wound edges are protected.	1. As described for open reduction of a fracture
2. The deep fascia is incised and retracted, and the vastus lateralis muscle split and retracted to expose the shaft and the trochanter of the femur (Fig. 528).	2. Smith-Petersen, Meyerding, or Bennett retractors, electrocoagulation unit, if requested, moist gauze packs and sponges

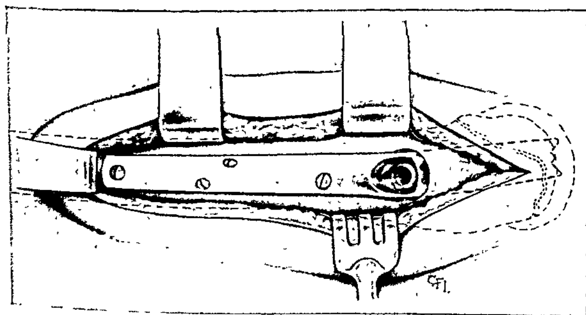


Fig. 532.—Internal fixation of trochanteric fracture Through an incision made in the lateral aspect of femur, position of guide pin is checked by x-ray pictures, and Jewett nail inserted, then the shaft portion of nail plate is fixed to femur by screws (From Speed, J. S, and Knight, R. A.. Campbell's Operative Orthopaedics, St Louis, 1956, The C V. Mosby Co)

Steps	*Items*
3. A hole is drilled at a point midway between the anterior and posterior cortices of the femur.	3. Kirschner drill and calibrated wires, Asepto syringe and normal saline solution
4. The guide wire is inserted at a 45-degree angle to the shaft. This angle may be increased by starting the insertion of the wire at a lower point on the shaft of the femur. X-ray pictures are then taken.	4. Guide wires, drill, sheet
5. The preferred nail is driven into the bone so that its plate will be flush with the shaft. The plate attachment is fixed to the shaft with screws; then x-ray pictures are taken. The guide pin may be removed before, during, or after insertion of the nail.	5. Desired appliance of appropriate sizes, sheet, screws, screw drivers (Figs. 530 to 532)
6. The wound is closed in layers and dressings are applied. In some cases a plaster-of-Paris hip spica is applied.	6. As described for open reduction of a fracture and items listed for application of body cast

Operations on Femoral Shaft Fractures

Definition.—*Emergency treatment* includes, if possible, the immobilization of the limb by means of a splint and fixed traction or a plastic spica.

Final treatment may include skeletal traction or internal fixation, the choice depending upon the condition of the fractured bone, its location, and the judgment of the surgeon [3, 4, 21]

Considerations.—Most fractures of the femoral shaft are caused by direct violence which results in short, oblique, or transverse fractures, and few result from indirect violence which produces a torsion force.[7] The latter situation usually causes a spiral fracture. Others are considered pathologic fractures due to the presence of metastatic carcinoma, Paget's disease of bone, and dysplasia. Patients with a fractured femur not only suffer severe pain and shock due to the injury itself, but often from associated injuries.[5]

Setup, Position, Skin Preparation, and Draping Procedure.—For skeletal fixation, an external reduction and plaster setup; for internal reduction, a hip-pinning setup, including suitable plates and screws, or nails, or intermedullary nails such as the Kuntscher type, or cloverleaf-shaped nail, or Hansen-Street diamond-shaped nail (Figs 486, 530, 531), also proper supports for the patient, x-ray equipment, and extra sterile sheets.

For insertion of the cloverleaf nail the leg frame of the fracture table is usually sterilized and the leg secured to it after the draping procedure has been completed.

Operative Procedure.—

1. *Skeletal Fixation.*—The Kirschner wire is placed through the lower end of the femur or through the upper end of the tibia.[4, 33, 34] The latter is pre-

ferred since the adjustment of the fractured fragments are more easily handled by changing the position of the knee. The appliance is not passed through the hematoma, femoral vessels, or the suprapatellar pouch. Plaster casing and traction are applied.

2. *Open Reduction With Internal Fixation.*—Through an anterolateral incision, depending upon the location and type of fracture, the bone ends are exposed and a metal appliance is applied.

For fractures of the middle third of the femur a 4- or 6-screw plate or an intermedullary nail may be used to stabilize the fragments (Figs. 482 and 486). Occasionally, an oblique spiral fracture may be held by screws alone. Subtrochanteric fracture fixation is accomplished by inserting a long Neufeld nail and screws, a Blount nail and screws, or, in some cases, an intramedullary nail (Figs. 530 and 531). Transverse fractures, especially those fractures of the upper and middle thirds of the femoral shaft, are held by means of intermedullary nailing.

Intermedullary Femoral Fracture

Definition.—The insertion of a nail through the intermedullary canal of the proximal and distal fragments of the femur, usually through a posterolateral incision (Figs 533 and 534).

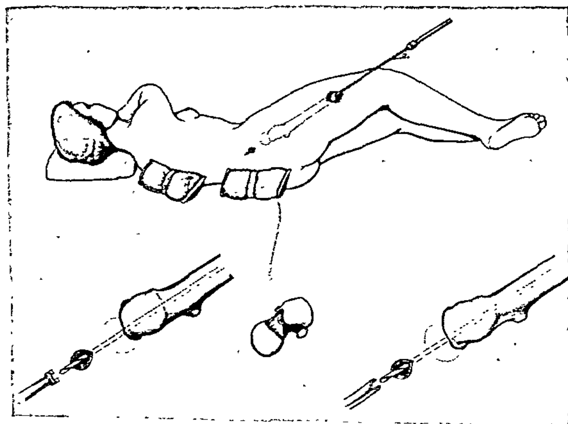


Fig 533—Details of insertion of medullary nail Guide pins emerge through small incision in upper outer quadrant and buttock. Trochanteric reamer placed over guide pin and holes drilled in correct alignment with medullary canal. Küntscher nail inserted into proximal femoral fragment over guide pin When nail has been driven down to level of fracture site, guide pin is removed and fracture reduced. Nail is then driven correct distance in distal fragment. (From Smith, H Radiology 61:194, 1953)

An anterolateral incision may be used, but this approach is hazardous due to the danger of cutting the nerve to the vastus lateralis that lies over the upper portion of the femoral shaft.

Setup, Position, Skin Preparation, and Draping Procedure.—Intermedullary setup, orthopedic fracture table, and supports for the extremities. The patient is placed on the fracture table in a supine position, with the affected thigh adducted and flexed and the body well supported (Chapter 4). Skin preparation

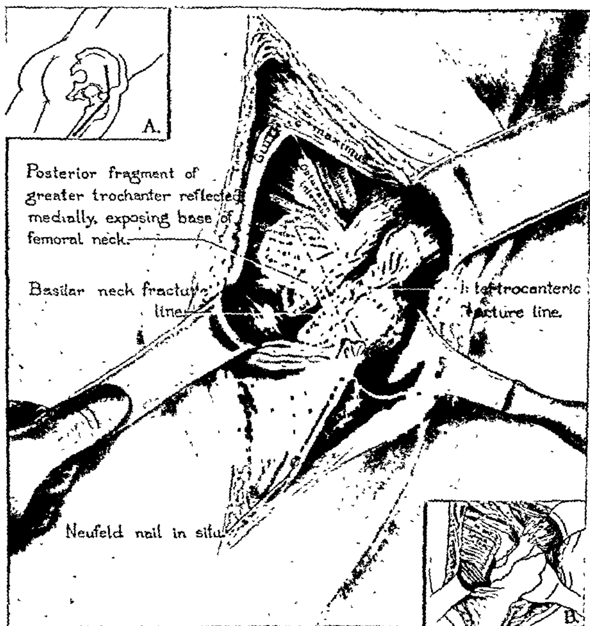


Fig. 534.—Posterolateral approach to neck, trochanter, and upper femoral shaft. Gluteus maximus muscle and fascia lata split, and vastus lateralis reflected subperiosteally from posterolateral surface of upper femur. Drawing illustrates fractures of both base of femoral neck and intertrochanteric regions. *A*, Line of skin incision. *B*, Posterior aspect of femoral neck exposed by division of insertions of obturator externus and quadriceps femoris muscles. This is necessary where there is no separate cristal or posterior trochanteric fragment that may be reflected. (From Horwitz, T.: Surg. Gynec. & Obst. 95:45, 1952.)

for hip operations is done (Fig. 12). The patient is draped with sheets as described previously (Fig. 506).

Operative Procedure.—

1. Through a posterolateral incision the fracture site is exposed, protected, and retracted (Fig. 531).

2. A nail is selected and tested to fit first the distal portion of the fractured bones according to their width and size and then the proximal fractured fragments. The fragments are reamed with a reamer that is one size smaller than the nail to be used.

3. The proximal fragment usually is reamed out up through the isthmus. This is the narrowest portion of the intermedullary canal, where the nail might get caught during its insertion.

4. A guide wire is driven in retrograde fashion up through the proximal fragment and out through the greater trochanter until it emerges through the skin at the level of the posterior lateral buttocks. Before this step is carried out the thigh must be adducted and flexed so that the "guide" pin will not be driven up into the chest or abdomen.

5. A skin incision is made around the guide pin; then a reamer is inserted over the guide wire. A hole is reamed into the top of the femur at the greater trochanter; then the nail is driven down over the guide wire until it emerges at the fracture site.

6. The fracture is reduced and the guide wire is driven through into the distal fragment after the surgeon has lined up the leg in regard to rotation. The distance the nail can be inserted into the distal fragment is checked by x-rays and then the guide wire removed.

7. The wound is closed and dressings are applied. The affected leg usually is placed under traction, but only for a few days.

Operations on the Tibia

Intermedullary Tibial Fracture

Definition.—Through a short incision made over the anterior aspect of the tibia and medial to the tibial tubercle a nail is inserted.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for intermedullary pinning For tibial nailing the patient is placed in a supine position on a fracture table. The affected knee is flexed, and the ankle is well padded with sheet wadding and fastened to the brace attached to the operating table. Countertraction is applied to the distal femur to facilitate reduction. After reduction is determined the skin area from the upper thigh to the ankle is cleansed. The patient is draped with sterile sheets, leaving the operative site exposed

Operative Procedure.—The items needed for each step are similar to those used in intermedullary pinning of a femoral fracture.

A small drill hole is made through the outer cortex at the bend of the mid-portion of the tibial tubercle. The nail is inserted in the drill hole with its

flange facing outward. It is driven down the fracture site and its position determined. The wound is closed and the affected leg encased in a cast.

Tibial Shaft Fracture

Definition.—For simple transverse fractures and many oblique fractures the fragments are reduced by external manipulation and the leg encased in a plaster cast. In the presence of severe fragmented fractures skeletal traction or the insertion of an appropriate appliance is preferred.

Considerations.—The most common sites of fractures of the tibia occur at the lower, middle, and junction of the lower and middle thirds of the tibial shaft. The fractures which result from a direct blow often are the transverse and compound types, whereas those which result from a twisting force are the spiral type.[3, 4, 7, 36, 41]

Setup, Position, Skin Preparation, and Draping Procedure.—Skeletal traction and plaster casing setups, or internal reduction setup with preferred and suitable plates and screws, or screws alone, or transfixing wires, or an intermedullary nail.

In nonunion cases a bone-grafting setup is needed.

Operative Procedure.—As described for closed or open reduction of a fracture.

Operations on Arm, Forearm, and Wrist Fractures

Definition.—*Reduction of the fracture and immobilization of the fragments* by means of external or internal fixation (Figs. 475 and 510).

Setup, Position, Skin Preparation, and Draping Procedure.—As for open or closed reduction of a fracture.

Considerations and Operative Procedures.—In fractures of the humerus there is often overriding and injury to the radial nerve. In supracondylar fractures of the humerus the distal fragments may be displaced, resulting in tension of the nerves, tendons, and vessels. If supracondylar fractures and dislocations of the humerus cannot be reduced, they are treated by internal fixation by means of wires, or plates, and screws or by overhead external skeletal traction applied through the olecranon.

Fractures of the olecranon process may be treated by open reduction with insertion of wire sutures, Rush nails, or long malleable screws.

Fractures of the forearm usually are treated by immobilization in a plaster cast, but in the presence of nonunion a bone grafting may be done to stimulate union. Some unreducible fractures are treated by bone plating or intermedullary fixation.

Fractures of the wrist and hand are reduced and maintained in immobilization either by a plaster cast or splint or by skeletal fixation with or without traction.

Operations on Ankle and Foot Fractures

Definition.—*Reduction of the fracture and immobilization of the fragments* by external fixation or by open reduction with fixation sutures, bolts, or screws.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for external and internal reduction of a fracture, respectively.

Considerations and Operative Procedure.—The type of fracture or dislocation of the ankle (including a Pott's fracture) is influenced by the intensity and duration of the direct or indirect force that is exerted on the ankle and foot. A fracture displacement of either the lateral or medial malleolus may involve a rupture of a main supporting ligament on the opposite side of the ankle. The latter would usually require surgery to avoid interposition and malreduction.

A posterior chip fracture of the tip of the tibia, which involves more than one of the articular surfaces, is treated by internal fixation if it cannot be reduced by a closed reduction operation.

A rupture of the lower tibia-fibular ligament, situated just above the ankle joint, usually is repaired by means of a transfixion bolt or screws.

In falls from a height the os calcis may become fractured, and the attachment of the tendo achillis may be avulsed by muscular contraction. The avulsion of the tendo achillis at its insertion or the displaced fracture of the tuberosity may be treated by open reduction and insertion of sutures. If there is marked involvement of the subastragaloid joint, arthrodesis may be done several weeks following the original injury.

Injuries of the metatarsal and phalanges may be treated by immobilization or skeletal fixation and traction.

Fractures and separation of the internal malleolus are usually treated by open reduction and fixation by means of screws or sutures.

Operations on the Patella

Patellectomy

Definition.—Excision of the bone portion of the patella and repair of the quadriceps expansions (Figs. 473*A*, *B*, 535, and 536).

Considerations.—Fractures of the patella are of the transverse, comminuted (stellate), or linear type. They are usually due to direct contusion or muscular stress. The fragments of bone, especially in a transverse fracture, may separate when the torn quadriceps muscle pulls them apart. If this occurs the quadriceps mechanism must be repaired. Linear or comminuted fractures in which the fragments do not separate are immobilized in a cast. If one pole of the patella is avulsed it is excised and the quadriceps is repaired.[10, 13]

Purpose.—A patellectomy is done to aid knee function if the patella is diseased or too severely injured to be remodeled.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for knee operations, including:

Mayo-Harrington scissors
Adson or Kirmisson rongeur
Lewin bone clamp
Meyerding, Hibbs, and Sauerbruch retractors
Fascia lata setup, if desired
Chromic gut Nos. 1, 0, 2-0
Stainless steel wire Nos. 2-0 to 4-0
Orthopedic leg pack
Skin preparation tray

flange facing outward. It is driven down the fracture site and its position determined. The wound is closed and the affected leg encased in a cast.

Tibial Shaft Fracture

Definition.—For simple transverse fractures and many oblique fractures the fragments are reduced by external manipulation and the leg encased in a plaster cast. In the presence of severe fragmented fractures skeletal traction or the insertion of an appropriate appliance is preferred.

Considerations.—The most common sites of fractures of the tibia occur at the lower, middle, and junction of the lower and middle thirds of the tibial shaft. The fractures which result from a direct blow often are the transverse and compound types, whereas those which result from a twisting force are the spiral type.[3, 4, 7, 30, 41]

Setup, Position, Skin Preparation, and Draping Procedure.—Skeletal traction and plaster casing setups, or internal reduction setup with preferred and suitable plates and screws, or screws alone, or transfixing wires, or an intermedullary nail.

In nonunion cases a bone-grafting setup is needed.

Operative Procedure.—As described for closed or open reduction of a fracture.

Operations on Arm, Forearm, and Wrist Fractures

Definition.—Reduction of the fracture and immobilization of the fragments by means of external or internal fixation (Figs. 475 and 510).

Setup, Position, Skin Preparation, and Draping Procedure.—As for open or closed reduction of a fracture.

Considerations and Operative Procedures.—In fractures of the humerus there is often overriding and injury to the radial nerve. In supracondylar fractures of the humerus the distal fragments may be displaced, resulting in tension of the nerves, tendons, and vessels. If supracondylar fractures and dislocations of the humerus cannot be reduced, they are treated by internal fixation by means of wires, or plates, and screws or by overhead external skeletal traction applied through the olecranon.

Fractures of the olecranon process may be treated by open reduction with insertion of wire sutures, Rush nails, or long malleable screws.

Fractures of the forearm usually are treated by immobilization in a plaster cast, but in the presence of nonunion a bone grafting may be done to stimulate union. Some unreducible fractures are treated by bone plating or intermedullary fixation.

Fractures of the wrist and hand are reduced and maintained in immobilization either by a plaster cast or splint or by skeletal fixation with or without traction.

Operations on Ankle and Foot Fractures

Definition.—Reduction of the fracture and immobilization of the fragments by external fixation or by open reduction with fixation sutures, bolts, or screws.

The patient is placed on the operating table in a supine position, with the affected knee joint at a level with the break of the lower section of the table. The foot section of the table is lowered or the knee is flexed by placing a suitable sandbag beneath its posterior aspect (Chapter 4). The extremity is cleansed as described previously, and the patient is draped with sheets as for draping a lower extremity. (Figs. 498 to 501.)

Operative Procedure.—The major steps include the following:

1. A curved, transverse or paramedian incision is made over the knee, and the capsular tendon ligament of the joint and the quadriceps tendon are exposed.
2. The patellar ligament is incised to expose the anterior surface of the patella.
3. The fragments of the patella are removed from the surrounding tendon by sharp dissection.
4. In some cases the quadriceps and patella tendon are sutured with chromic gut or stainless steel wire.
5. The defect in the patellar ligament is closed with sutures, with an autogenous fascia lata graft, or by turning down a flap of quadriceps fascia from above.

Recurrent Dislocation of the Patella

Definition.—Through an open wound, medial transplantation and fixation of the patella tendon and its bony attachments to the tibia or plication of the soft tissues on the medial side of the patella tendon.

Considerations.—Recurrent dislocation of the patella may originate from the direct blow against its inner side when the knee is flexed. More often it is a congenital developmental phenomenon associated with a shallow groove in the femoral condyles, a ball-shaped patella, or knock-knee.[10]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for internal reduction of fractures and knee operations. An osteotomy setup may be required to reconstruct a severe knock-knee.

Operative Procedures.—One of several operations may be done, depending upon the condition. The most common operations are (1) transference of the patella tendon and its bony attachments inward on the tibia; (2) wedge osteotomy of the lateral femoral condyle; or (3) tendon or fascia lata fixation of the patella to the inner condyle of the femur.

Reconstruction Operations

The Whitman Reconstruction Operation on the Hip

Definition.—Removal of the femoral head, remodeling of the femoral neck to fit the acetabulum, osteotomy on the greater trochanter and stabilizing it lower on the shaft[3, 4, 7, 13, 17, 33, 43]

Considerations.—In the presence of nonunion or fibrotic union of the femoral neck, the patient must use crutches for walking because of a limp due to instability of the nonunited hip (Fig. 525). One of several methods may be used to relieve pain and to provide stability. The choice of treatment depends on the viability of the femoral head.

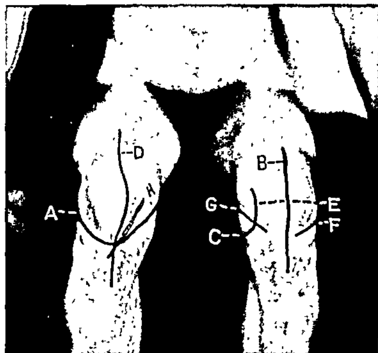


Fig 535 —Various incisions for operations on the knee joint. (From Key, J. A, and Conwell, H E: The Management of Fractures, Dislocations and Sprains, St Louis, 1956, The C. V. Mosby Co)

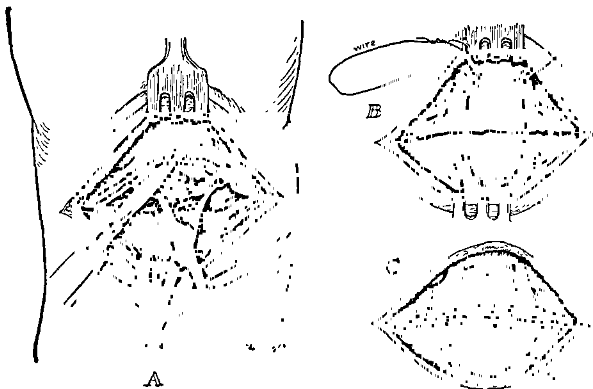


Fig 536 —Patellectomy for comminuted fracture of patella *A*, Fragments exposed and excised through transverse incision *B*, Quadriceps and patellar tendons joined by mattress suture of stainless steel wire *C*, Repair completed (From Speed, J. S, and Knight, R. A: Campbell's Operative Orthopaedics, St Louis, 1956, The C V Mosby Co)

The patient is placed on the operating table in a supine position, with the affected knee joint at a level with the break of the lower section of the table. The foot section of the table is lowered or the knee is flexed by placing a suitable sandbag beneath its posterior aspect (Chapter 4). The extremity is cleansed as described previously, and the patient is draped with sheets as for draping a lower extremity. (Figs. 498 to 501.)

Operative Procedure.—The major steps include the following:

1. A curved, transverse or paramedian incision is made over the knee, and the capsular tendon ligament of the joint and the quadriceps tendon are exposed.
2. The patellar ligament is incised to expose the anterior surface of the patella.
3. The fragments of the patella are removed from the surrounding tendon by sharp dissection.
4. In some cases the quadriceps and patella tendon are sutured with chromic gut or stainless steel wire.
5. The defect in the patellar ligament is closed with sutures, with an autogenous fascia lata graft, or by turning down a flap of quadriceps fascia from above.

Recurrent Dislocation of the Patella

Definition.—Through an open wound, medial transplantation and fixation of the patella tendon and its bony attachments to the tibia or plication of the soft tissues on the medial side of the patella tendon.

Considerations.—Recurrent dislocation of the patella may originate from the direct blow against its inner side when the knee is flexed. More often it is a congenital developmental phenomenon associated with a shallow groove in the femoral condyles, a ball-shaped patella, or knock-knee.[10]

Setup, Position, Skin Preparation, and Draping Procedure.—As described for internal reduction of fractures and knee operations. An osteotomy setup may be required to reconstruct a severe knock-knee.

Operative Procedures.—One of several operations may be done, depending upon the condition. The most common operations are (1) transference of the patella tendon and its bony attachments inward on the tibia; (2) wedge osteotomy of the lateral femoral condyle; or (3) tendon or fascia lata fixation of the patella to the inner condyle of the femur.

Reconstruction Operations

The Whitman Reconstruction Operation on the Hip

Definition.—Removal of the femoral head, remodeling of the femoral neck to fit the acetabulum, osteotomy on the greater trochanter and stabilizing it lower on the shaft.[3, 4, 7, 13, 17, 33, 43]

Considerations.—In the presence of nonunion or fibrotic union of the femoral neck, the patient must use crutches for walking because of a limp due to instability of the nonunited hip (Fig. 525). One of several methods may be used to relieve pain and to provide stability. The choice of treatment depends on the viability of the femoral head.

The Whitman operation on the hip is done on most patients in whom the head of the femur is not viable, but where a considerable portion of the femoral neck is viable.

Setup, Position, Skin Preparation, and Draping Procedure.—As described in internal fixation and arthroplasty of hip.

Operative Procedure.—The major steps include the following:

1. A curved skin incision is made, extending one inch posterior to the anterosuperior iliac and ending about three inches below the apex of the greater trochanter (Fig. 528).
2. The capsule is opened, the head of the femur is removed, and the base of the trochanter is cut through in line with the axis of the neck.
3. The remaining end of the femoral neck is remodeled and fitted into the acetabulum; then the trochanter is transplanted downward onto the outer surface of the shaft of the femur by means of screws or wire sutures which are passed through drill holes.
4. The hip is abducted about 20 degrees, the wound is closed in layers, and dressings are applied. The patient is placed in a plaster hip spica.

The Colonna Reconstruction Operation

Definition.—Removal of the femoral head, reduction of the trochanter into the acetabulum, and suture fixation of the abductor muscles to the shaft below the trochanter, thereby providing abduction power.

Considerations.—The Colonna operation is done if the femoral neck has been completely absorbed and the head of the femur is necrotic.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for arthroplasty of the hip and internal reduction of a fracture.

Operative Procedure.—The major steps include the following:

1. An anterolateral skin incision is made over the thigh and the wound edges are protected, as for open reduction.
2. The greater trochanter, neck, and acetabulum are exposed, and the nail is removed, if present (Fig. 529). The muscles are detached from the greater trochanter, and the capsule is freed and divided. Periosteal elevators, knife, scissors, and osteotomes are required (Figs. 483 and 481).
3. The ligamentum teres is divided, the head of the femur is removed, and the trochanter is reduced into the acetabulum (Figs. 470 and 471). Rongeurs, bone-cutting forceps, long scissors, deep retractors, and a long scalpel are required.
4. The superior portion of the capsule and the lesser gluteal muscles are sutured with chromic gut to the periosteum shaft below the greater trochanter (Fig. 472).
5. The wound is closed in layers and dressings are applied to the wound. The patient is immobilized in a double plaster spica with the affected hip in abduction.

Shelf Reconstruction Operation

Definition.—A wedge or shelf of bone is placed over the top of the femoral head to deepen the acetabulum.

Purpose.—A shelf-type operation is done to help stabilize a congenital dislocation of the hip.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for arthroplasty of the hip and internal reduction of a fracture.

Operative Procedure.—The major steps include the following:

1. Through an anterior or lateral approach the head and neck of the femur are exposed. The capsule of the hip joint is opened.
2. The femoral head is reduced as nearly as possible to its normal relationship to the ilium. A shelf of bone is formed by turning down a flap of bone from the ilium so that it extends to the top of the acetabulum.
3. Latch-stick bone grafts and chips, which are obtained from the ilium or from the bone bank, are placed above the shelf of bone. The wound is closed in layers and a plaster hip spica cast is applied.

Dislocation of the Hip

General Considerations.—Although dislocation of the hip does not commonly occur, it may be caused by a severe blow which displaces the head of the femur out of the acetabulum. In some injuries the head of the femur is pushed centrally, carrying with it the floor of the acetabulum. In such conditions the lower extremity on the affected side appears to be shortened, and occasionally the rim of the acetabulum or head of the femur may be fractured.

A pathologic dislocation of the hip may be caused by (1) a severe infectious disease such as scarlet fever, typhoid fever, or tuberculosis, (2) infantile paralysis, or (3) a chronic arthritis resulting in destruction of the femoral head or the acetabulum.

The term congenital dislocation includes various degrees of displacement of the femoral head from its normal position, as well as subluxations.[3, 4, 8, 31] In some advanced cases a shelf reconstruction operation is done; however, open reduction sometimes is necessary in the early stages of the disease.

The choice of operation depends on the degree of injury and the condition of the patient. The types of operations that may be done to treat a dislocation of the hips include (1) closed reduction with immobilization by plaster spica, (2) open reduction with screw fixation for the reducible fragments, (3) arthrodesis, or (4) arthroplasty.

Open Reduction for Dislocation of the Hip

Definition.—Reduction of the femoral head, removal of loose fragments of bone from the joint, replacement of the acetabular fragment, or fixation by means of bone pegs or a metal appliance.

Setup, Position, Skin Preparation, and Draping Procedure.—As for open reduction of fracture, and arthroplasty setup on a hip.

Operative Procedure.—The major steps include the following:

1. A skin incision, about 6 inches long, is made extending from the posterosuperior spine to the upper border of the greater trochanter and the long femur. Bleeding vessels are controlled and the wound edges are protected and retracted.
2. The muscles are divided and retracted to expose the capsule of the joint.
3. The capsule is incised to expose the femoral head and neck.
4. The acetabulum is exposed. Bone fragments, scar tissue, or fibrotic bands are removed, and the head of the femur is reduced.
5. The bone fragments may be replaced and fixed by means of bone pegs, stainless steel sutures, or vitallium screws or nails.
6. The joint capsule, muscle, fascia, and skin are closed in layers. The wound is dressed, and the patient is placed in a body cast which extends from the rib margin down to the knees.

Arthroplasty Operations

Definition.—Reconstruction of the articular surfaces of the affected joint, with removal of a portion of bone between the bone ends to provide free movement in various directions; insertion of a substance, usually fascia lata, over the bony surfaces to permit a gliding movement and to separate the raw bony surfaces comprising the new joint.

Purpose.—To restore function and to decrease pain.

Considerations.—An arthroplasty is done to treat a joint which has become destroyed following trauma, arthritis, or a pyogenic infection, but it is not done until the active infection has subsided. If a patient has rheumatoid (atrophic) arthritis it may be done after the acute stage of the infection has passed.[13, 17, 32, 43]

Contraindications.—This procedure is not done in children before the epiphyses have been united. Its results will not be satisfactory for weight-bearing joints in those patients who do heavy manual labor. In such patients a stiff joint stabilized by bone fixation is usually preferable to a joint that is obtained by arthroplasty

Arthroplasty of the Hip

Definition.—Through an anterolateral, lateral, or posterolateral incision the diseased joint is severed, the hip dislocated, and the articulating surfaces remodeled with the aid of fascia lata, a metallic cup, or a prosthetic replacement of the upper femur into the acetabulum

Considerations.—The hip joint's function may be markedly limited by a degenerative lesion mentioned previously Trauma is believed to be a most significant factor. Degenerative arthritis may follow an accident, or it may appear many years later in patients who had childhood epiphyseal disturbances.[3, 4, 8]

When a hip is reconstructed the absorbed head of the femur may be replaced by a plastic or metal prosthesis The principle of the mold arthroplasty is the interposition of a permanent inert barrier between two joint surfaces. To minimize friction, the mold must be loosely fitted to allow an adequate degree of motion between it and the adjacent reshaped surfaces of the acetabulum and the femoral head.

Setup, Position, Skin Preparation, and Draping Procedure.—As described for open reduction of fracture and for hip reconstruction operation, including vitallium cup set, wood screw set, and fascia lata graft (Fig. 487). The patient is placed on the operating table in a semilateral position. Routine skin preparation is done, and a hip draping procedure is carried out.[8, 43, 44]

Operative Procedure (Anterolateral Approach).—The steps and items include the following:

1. The skin is incised, bleeding vessels are controlled, and the wound edges are protected and retracted.

2. The crest of the ilium and attached muscles are exposed. The muscles are divided and the hip joint is exposed.

3. The capsule of the hip joint is incised, and the Y-ligament is divided.

4. The hip is dislocated by adduction and external rotation to expose the head and the neck of the femur and the acetabulum.

5. The upper femur is osteotomized and reamed at a proper level and angle to receive the prosthesis, using gouges, rasps, rongeurs, reamer, osteotomes, and mallet (Figs. 484 and 537).

6a. Fascia lata is inserted (Fig. 538). If an autograft is to be used a fascia lata setup is used to obtain a large sheet of fascia lata from the thigh on the affected side. The fascial graft is folded back on itself so that the rougher superficial surface is transplanted against the raw bone. One end of the fascial graft is sutured to the tissue that is attached to the upper margin of the acetabulum, the free portion is brought around the raw surface of the acetabulum, and then fastened around the femoral head. The graft is secured in place by drilling holes in the femoral neck and passing sutures in a purse-string fashion through the holes in the femoral neck and in the fascial graft. The femoral head is placed in the acetabulum, and the fascial layer rests between the articulating bony surfaces. The capsule is closed.

6b. A metallic cup or mold is inserted. The surfaces of the acetabulum and the head of the femur are remodeled by means of gouges, reamers osteotomes, and chisels of various sizes. Over the head of the femur is placed a suitable metal cup which will allow the greatest possible range of motion between it and the reshaped surfaces of the acetabulum and the femoral head (Fig. 472).

6c. A prosthesis is inserted into the femoral neck, following the Thomas or the Moore technique The hip is dislocated the femoral neck is sawed off or trimmed, and the socket is cleaned out with a ball-type reamer. If necessary, the femoral neck is prepared for the reamer. A hole is drilled in the canal of the neck and down into the shaft. A Thompson or Austin-Moore neck reamer is threaded through the drilled hole, and the neck is prepared for the appropriate prosthesis; its stem is driven into the hole in the neck of the femur (Fig. 487).

7. The hip joint is reduced. The wound is closed in layers and dressings are applied.

8. Postoperatively, abduction and neutral alignment of the extremity must be maintained until a balanced support or traction has been applied with the body in this position. A plaster spica hip cast may be used.

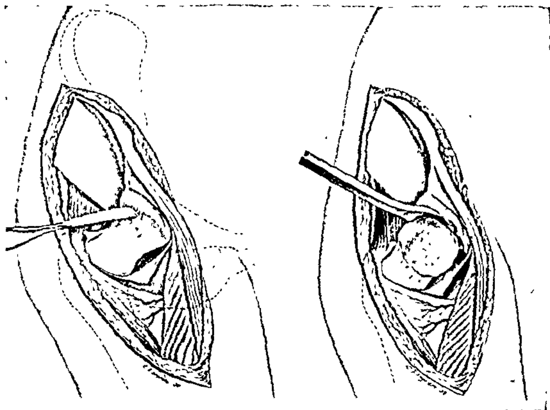


Fig 537 —Arthroplasty of the hip The articular surfaces of head of femur and acetabulum smoothed with special reamers (From Speed, J. S, and Knight, R. A. Campbell's Operative Orthopaedics, St. Louis, 1956, The C V Mosby Co)

Fig 538 —*Method of lining hip joint with double layer of fascia lata.* (*From Speed, J. S*, and Knight, R. A Campbell's Operative Orthopaedics, St Louis, 1956, The C. V. Mosby Co)

Arthroplasty of the Knee Joint

Definition.—Through a long paramedian incision in the anterior surface of the knee joint, bones of the joint are remodeled and fascia lata is secured around the femoral end.

Considerations.—Arthroplasty is done when function of the joint has been seriously restricted.[5]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for open reduction of the knee, including bone curettes, osteotomes, chisels, raspatories, and rongeurs; orthopedic leg pack, skin preparation tray, and plaster splint setup.

The patient is placed on the operating table in a supine position, with the knees at the level of the lower break section of the table. The knee may be flexed by breaking the table. The posterior portion of the knee should be supported by a pad, and the leg should rest on the table pad. The skin area is cleansed, and the leg draping procedure is carried out.

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. Through a long incision the quadriceps tendon is dissected free from the femur. The patella is separated from the femur. The skin edges are protected.	1. Scissors, tissue forceps, Mayo-Pean hemostats, Ochsner forceps, scalpel, tenotomy knives, bone hook, Lahey forceps, skin towels
2. The bony union, lying between the tibia and femur, is divided so that the knee can be fully flexed.	2. Osteotomes, chisels, curettes, rongeurs, rasp, moist sponges, saline solution, Asepto syringe
3. In some cases the articular ends (condyles) of the tibia are fashioned to resemble a normal shape (Fig. 472). However, in all cases the lower femoral portion is always made convex, and the upper tibial portion is excised only enough to reach healthy bone. The raw bony surfaces are approximated, as described for arthroplasty.	
4. The patella is removed and the bony surfaces are smoothed off. In some cases the patella is excised before the osteotomy is done.	4. Elevators, bone hook, sequestrectomy forceps, scissors, Asepto syringe, saline solution, gauze sponges, rongeurs, raspatories, gouges, mallet
5. A strip of fascia lata is obtained from the opposite thigh.	5. Fascia lata setup on separate tray, gloves, and gowns
6. The piece of fascia is wrapped around the end of the femur and sutured in place.	6. Chromic gut No. 1 or 0 sutures threaded on ½-circle Murphy or Mayo needles with trocar or taper points
7. The wound is closed in layers, and surgical dressings and bandages are applied to the wound. The leg is immobilized in a plaster splint.	7. As described for open or closed reduction

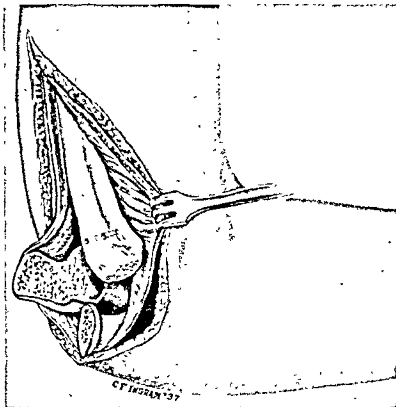


Fig. 539.—Articular surfaces of elbow joint remodeled, forming one humeral condyle. (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V. Mosby Co.)

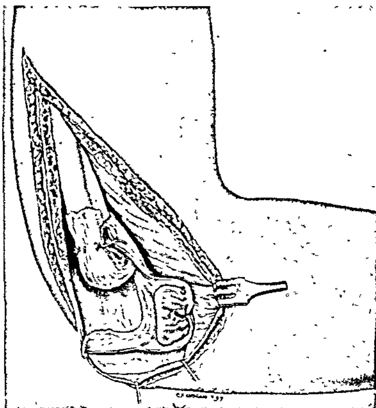


Fig. 540.—Fascia lata interposed between articular surfaces of ulna and humerus, and radius and ulna. (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, 1956, The C. V. Mosby Co.)

Arthroplasty of the Elbow

Definition.—Reconstruction of the elbow joint and interposition of fascia lata between the articulating surfaces (Figs. 539 and 540).[4, 9, 16, 23]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for an open shoulder operation, including osteotomes, chisels, and gouges, raspatories, elevators, curettes, rongeurs, also fascia lata setup, draping pack for upper extremity, and body supports.

The patient is placed on the operating table in a supine position, with the affected arm extended on an armrest. Routine skin preparation and draping procedure for a shoulder are carried out.

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. The operative skin area is exposed, incised, and protected (Fig. 519).	1. As described for internal reduction of a fracture
2. The fascia and triceps aponeurosis are incised, exposing the humerus and the head of the radius.	2. Scalpel, tissue forceps with teeth, Roux, Hibbs, or Volkman retractors, Crile or Mayo-Pean hemostats, chromic gut ligatures, scissors, moist sponges on holders or on tissue forceps without teeth
3. The periosteum is stripped over the lower third of the humerus.	3. Periosteal elevator, raspatory, sponges on holders
4. The fusions between the olecranon and the humerus, and the radius and the humerus are severed.	4. Raspatories, osteotomes, mallet, drill and fine drill points, straight and curved chisels, moist sponges, tissue forceps
5 The ulnar nerve is protected. The joint is flexed and dislocated at the mesial aspect.	5. Small moist pads, retractors, scissors
6. The lower extremity of the humerus is fashioned into one condyle. The head of the radius is exposed. The bony end surfaces are smoothed and shaped with jointlike surfaces. The wound may be irrigated.	6. Periosteal elevators, bone file, rongeurs, curved chisels, osteotomes, mallet, raspatory, Asepto syringe, normal saline solution, basin, gauze sponges, small pad, tissue forceps, surgical towel, fine bone-grasping forceps
7. A strip of fascia lata of a sufficient size to cover the remodeled joint is removed from the lateral aspect of the thigh.	7. A second "scrubbed" nurse assists the operators as they obtain the fascia, using a separate instrument setup

Second operating team obtains the fascial graft from the thigh and closes its wound. In some cases the packaged sterile fascia lata or membrane is preferred.

Steps	*Items*
8a. The bony surfaces are covered with the membrane or fascia; the periosteum and fascia are closed. The triceps aponeurosis, if severed, is sutured. The tourniquet, if used, is loosened. The skin edges are approximated, and the wound surfaces are covered with dressings. The elbow is immobilized in a splint or cast to prevent rotation.	8a. Tissue forceps, interrupted sutures chromic gut No. 0 or monofilament wire No. 3-0 or 2-0 on Mayo needles No. 4 cutting point, needle holders, hand drill, if desired, interrupted chromic gut No. 2-0, or wire No. 5-0, also skin sutures wire No. 6-0 or nylon 4-0 or 5-0 threaded on 3/8-circle cutting-edge needles, compression dressing, plaster-of-Paris setup for arm cast, or splint and bandages

Note: In some cases a plastic or metal prosthesis may be used. Replacements of both joint surfaces of the elbow or knee are now being presented.

Arthrodesis (Fusion) Operations

Definition.—The articular surfaces of two or more bones of the joint are united or fused by means of metal nails, screws, or bolts, or by a bone graft operation.

Considerations.—At present, this operation is indicated to treat tuberculosis of joints or those joints impaired and painful due to trauma or other lesion such as tumor or infection. Some deformities, such as spastic paralysis, clubfoot, and those produced by muscle imbalance or instability as a result of anterior poliomyelitis, may be treated by arthrodesis.[3, 4, 13, 21, 32]

Purpose.—To eliminate joint motion.

Arthrodesis of the Hip

Definition.—An osteotomy and fusion of the hip joint with insertion of a bone graft from the ilium or femur, and internal fixation with a metal nail.

Considerations.—Extra-articular fusion is frequently preferred, and generally it is done to treat tuberculosis. The Watson-Jones procedure, which includes internal fixation by insertion of a Smith-Petersen nail, may be used in treating adults who have a nontuberculous lesion of the hip. However, supplementary bone grafts are most important.[3, 4, 6]

Setup, Position, Skin Preparation, and Draping Procedure.—As for hip reconstruction operation, including wide osteotomes, bone graft setup, Kirschner wires and nail set, if desired, and fracture table and attachments. In extra-articular arthrodesis, with a graft taken from the femur, the patient may be placed on the operating table in a prone position but resting in a previously prepared anterior half of a double hip spica; or he may be placed on the fracture table in a supine position with his body adequately supported by pads and braces.

Operative Procedure.—

Hibbs Method.—The major steps include the following:

1. An incision is made over the lateral aspect of the upper third of the femur. Bleeding is controlled and the wound edges are protected as for open reduction.

2. The deep fascia and muscles are separated and retracted to expose th joint capsule.

3. The periosteum of the femur is cut along the base of the trochante then elevated; an anterior portion of the trochanter is cut off (Fig. 541) Several osteotomes and chisels are required.

4. The capsule is split and the cortex is removed from the superior aspe of the femoral neck.

5. The graft of the trochanter and the shaft cortex are rotated to fit th lower end of the ilium. The trochanteric end is wedged against the tip of th trochanter.

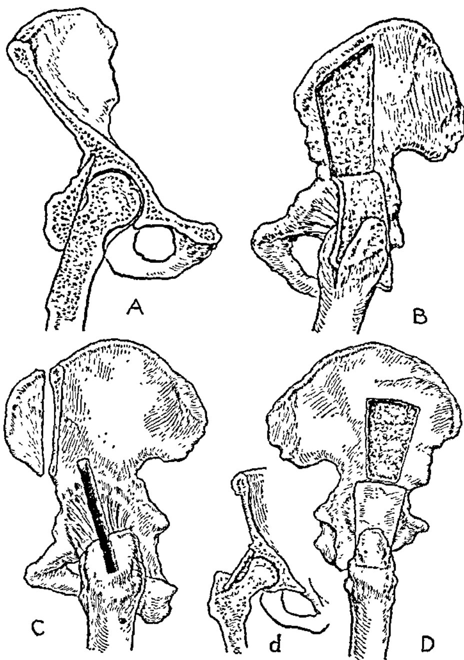


Fig 541 —Intra-articular and extra-articular (para-articular) arthrodesis of hip, *A*, Hibbs; *1* John C. Wilson; *C*, Ghormley; *D*, Henderson. (From Speed, J. S., and Knight, R. A: *Camp* bell's Operative Orthopaedics, *St Louis, 1956*, The C. V. Mosby Co)

Steps	*Items*
8a. The bony surfaces are covered with the membrane or fascia; the periosteum and fascia are closed. The triceps aponeurosis, if severed, is sutured. The tourniquet, if used, is loosened. The skin edges are approximated, and the wound surfaces are covered with dressings. The elbow is immobilized in a splint or cast to prevent rotation.	8a. Tissue forceps, interrupted sutures chromic gut No. 0 or monofilament wire No. 3-0 or 2-0 on Mayo needles No. 4 cutting point, needle holders, hand drill, if desired, interrupted chromic gut No. 2-0, or wire No. 5-0, also skin sutures wire No. 6-0 or nylon 4-0 or 5-0 threaded on 3/8-circle cutting-edge needles, compression dressing, plaster-of-Paris setup for arm cast, or splint and bandages

Note: In some cases a plastic or metal prosthesis may be used. Replacements of both joint surfaces of the elbow or knee are now being presented.

Arthrodesis (Fusion) Operations

Definition.—The articular surfaces of two or more bones of the joint are united or fused by means of metal nails, screws, or bolts, or by a bone graft operation.

Considerations.—At present, this operation is indicated to treat tuberculosis of joints or those joints impaired and painful due to trauma or other lesion such as tumor or infection. Some deformities, such as spastic paralysis, clubfoot, and those produced by muscle imbalance or instability as a result of anterior poliomyelitis, may be treated by arthrodesis.[3, 4, 13, 21, 32]

Purpose.—To eliminate joint motion.

Arthrodesis of the Hip

Definition.—An osteotomy and fusion of the hip joint with insertion of a bone graft from the ilium or femur, and internal fixation with a metal nail.

Considerations.—Extra-articular fusion is frequently preferred, and generally it is done to treat tuberculosis. The Watson-Jones procedure, which includes internal fixation by insertion of a Smith-Petersen nail, may be used in treating adults who have a nontuberculous lesion of the hip. However, supplementary bone grafts are most important[3, 4, 6]

Setup, Position, Skin Preparation, and Draping Procedure.—As for hip reconstruction operation, including wide osteotomes, bone graft setup, Kirschner wires and nail set, if desired, and fracture table and attachments. In extra-articular arthrodesis, with a graft taken from the femur, the patient may be placed on the operating table in a prone position but resting in a previously prepared anterior half of a double hip spica; or he may be placed on the fracture table in a supine position with his body adequately supported by pads and braces.

Operative Procedure.—

Hibbs Method.—The major steps include the following:

1. An incision is made over the lateral aspect of the upper third of the femur. Bleeding is controlled and the wound edges are protected as for open reduction.

Steps	*Items*
6. Patella tendon and capsule are sutured (Fig. 536).	6. Interrupted chromic gut No. 1 threaded on Martin needles No. 7, needle holder, tissue forceps, and scissors
7. The wound is closed in layers, dressings are applied, and the leg is immobilized in a cast.	7. As described for open reduction of a fracture and plaster setup.

Arthrodesis of the Spine

Definition.—In the Albee operation the spinous processes are united into one continuous bony bridge by means of a graft transplanted from the tibia.

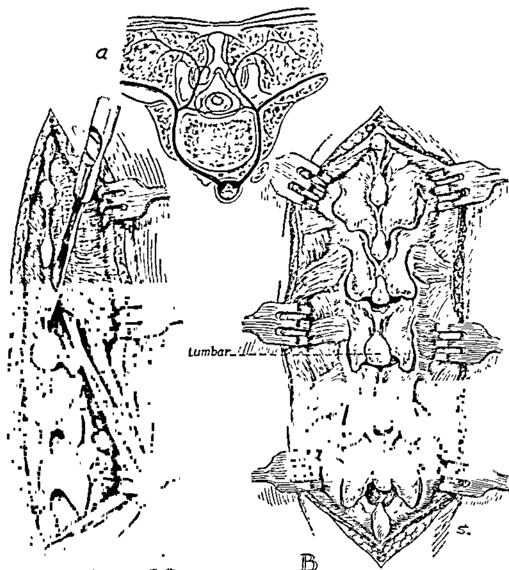


Fig 542.—Arthrodesis of the spine Lumbar disc approach to posterior aspect of spine. *A*, Muscle insertions are freed subperitoneally from lateral side of spinous processes and interspinous ligaments, dissection proceeds proximally, the periosteal elevator being held against the bases of spinous processes. *B*, Spinous processes laminae and articular facets exposed. *C*, Cross section of arteries supplying posterior spinal muscles, showing proximity of internal muscular branch to spinous processes (From Speed, J S, and Knight, R A., Campbell's Operative Orthopaedics, St Louis, The C V. Mosby Co)

6. The periosteum of the graft is sutured to the periosteum of both the ilium and the femur.

7. The wound is closed in layers; dressings and plaster spica are applied.

Britain Method.—The subtrochanteric area is osteotomized, a broad tibial bone graft is placed through the osteotomy and inserted into the ischium, and the femoral fragments are placed against the pelvis.

Arthrodesis of the Knee

Definition.—Osteotomy and fusion of the joint with insertion of metal screws or a nail. Compression arthrodesis by the use of transfixion by Steinmann pins inserted through the femur and tibia and incorporated in turnbuckle clamps as described by Charley is an excellent method in treating difficult cases.[10]

Setup, Position, Skin Preparation, and Draping Procedure.—As for a knee operation, including Adson, Kirmisson, and Bacon rongeurs, osteotomes, chisels, gouges, bone-holding clamp, raspatories, elevators, and fixation bars, intermedullary nails, wood screws, or Smith-Petersen nail, if desired.

Operative Procedure.—The steps and items include the following:

Steps	*Items*
1. An incision is made encircling the patella. The skin edges are protected.	1. As for open reduction of a fracture
2 The patella tendon and capsule are divided. The patella is turned upward (Figs. 473*A* and 473*B*).	2. Scalpel, curved scissors, tissue forceps, sponges, Hibbs and Volkman retractors, bone-holding forceps
3. The cartilage is removed from the joint surface of the patella (Fig. 536).	3. Chisel, mallet, osteotomes, blade saw, rongeurs, bone-holding forceps
4 The joint cartilage and ends of the femur and tibia are removed. The bone flaps are dissected free	4. Saw, chisels, rongeur, Mayo-Pean forceps, sponges on holders
5a A graft may be taken from the adjacent tibia or femur, if desired. The graft is placed across the knee joint in a slot cut for this purpose and is held in place by sutures or bone peg nails	5a. Scalpel, tissue forceps for the skin, electric saw or chisel and mallet, warm moist saline solution, gauze sponges, bone-cutting forceps, bone-holding forceps, interrupted chromic gut No. 0 or 1 on ½-circle trocar-point needle No. 3, or bone peg nails or screws, drill set, screw drivers
5b. To prevent angulation, crossed heavy pins, screws, long Smith-Petersen nail, Kuntscher intermedullary nail, or external fixation appliance such as Haynes or Roger-Anderson may be used.	5b. Wood screws of various sizes, driver, drill and drill points, or intermedullary set, hammer, or skeletal fixation set

5c The grafts from the patella or the excised cancellous bone chips from the tibia are inserted into the tibial and femoral flaps.

Steps	*Items*
6. Patella tendon and capsule are sutured (Fig. 536).	6. Interrupted chromic gut No. 1 threaded on Martin needles No. 7, needle holder, tissue forceps, and scissors
7. The wound is closed in layers, dressings are applied, and the leg is immobilized in a cast.	7. As described for open reduction of a fracture and plaster setup.

Arthrodesis of the Spine

Definition.—In the Albee operation the spinous processes are united into one continuous bony bridge by means of a graft transplanted from the tibia.

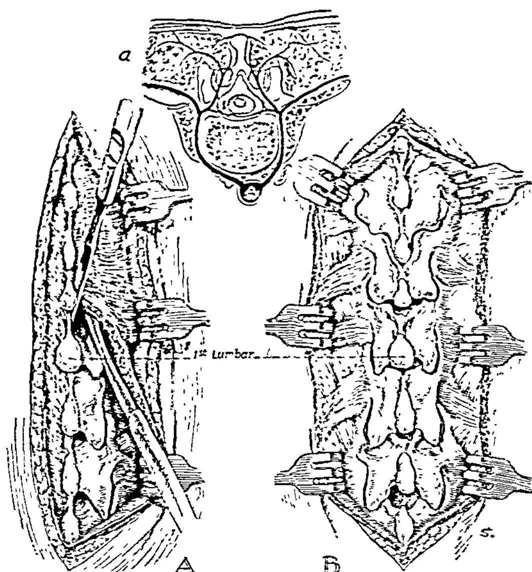


Fig. 542.—Arthrodesis of the spine. Lumbar disc approach to posterior aspect of spine. *A*, Muscle insertions are freed subperitoneally from lateral side of spinous processes and interspinous ligaments; dissection proceeds proximally, the periosteal elevator being held against the bases of spinous processes. *B*, Spinous processes laminae and articular facets exposed. *C*, Cross section of arteries supplying posterior spinal muscles, showing proximity of internal muscular branch to spinous processes. (From Speed, J. S., and Knight, R. A.: Campbell's Operative Orthopaedics, St. Louis, The C. V. Mosby Co)

In the Hibbs operation the posterior neural arch is fused by overlapping numerous small osseous flaps from contiguous laminae, spinous processes, and articular facets. Modifications of these two techniques and one of several different types of grafts are now used.

Purpose.—A spinal arthrodesis or fusion is done to treat a congenital, traumatic, or degenerative lesion, or infective processes.[4, 5, 8]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as for spinal fusion. The patient is placed on a modern operating table in a prone position (Chapter 4). The operating table may be broken to elevate the superior spines and reduce strain on the abdominal and thoracic muscles and nerves, or a special table pad may be used. The proposed operative site is cleansed and surrounded by four sterile towels, which are held in place with towel forceps or sutures. If a graft is to be taken the affected leg is draped with sheets, as for a bone operation. A spinal fenestrated sheet is draped over the patient in such a manner that it does not cover the draped leg, which is then covered with a small sheet until the graft is to be taken.

Operative Procedure.—The steps and items, as shown in Figs. 489, 490, and 542, include the following:

Steps	*Items*
1. A midline incision is carried down to the underlying osseous prominences to be fused. Bleeding vessels are ligated.	1. Sponges, scalpel, tissue forceps, Crile hemostats, sutures—chromic gut No. 2-0 or silk No. 3-0, scissors
2. The surgical towels are applied to the skin edges. The wound edges are retracted.	2. Two towels, silk sutures on skin needles, or towel forceps, Roux retractors
3. The ligamentous and tendinous attachments to the bone are dissected. The soft tissues are dissected away from the bone. Bleeding vessels are controlled.	3. Hibbs retractors, scalpel, tissue forceps, moist sponges, small pads, sharp, broad periosteal elevators, raspatory, fusion pads, sponges, normal saline solution and Asepto syringe, ligatures, or electrosurgical machine
4. The tissues and muscles are retracted	4. Self-retaining retractor, Hibbs retractors
Hibbs Method.—	
5a (1) Cartilage is removed from the articular joints of the desired vertebras.	5a. (1) Curved and straight curettes Nos 3-0 and 2-0, thin straight and angular osteotomes, mallet
(2) The superior and inferior borders of the laminae are split off and the bone fragments are fractured at their base. The osseous fragments from the laminae are interlaced	(2) Gouges, straight and angled, mallet, forceps, sponges, fusion pads, compressed cotton

Steps	*Items*
(3) The spinous processes are cut and shifted downward so that each process is in contact with a raw surface.	(3) Bacon rongeur, Ochsner forceps, pads, suction set, warm normal saline solution, Asepto syringe
(4) Free bone chips may be placed in the denuded articular process joints.	(4) Wooden board, scalpel, curette to remove tissue from the bony chips
(5) The bone chips may be transfixed with screws or plate and screws. Screws are sometimes transfixed through the articular facets.	(5) Bone screw insertion setup
Albee Method.—	
5b. (1) The supraspinous and interspinous ligaments are divided.	5b. (1) Retractors, scalpel, tissue forceps, scissors, gauze and compressed cotton, sponges
(2) The spinous processes are exposed and split and the bases of the spinous processes on one side are fractured, so that a gutter is formed.	(2) Bacon rongeurs, periosteal elevators and raspatories, mallet, gouges, chisels, osteotomes, sponges, fusion pads, suction set
(3) A full-thickness tibial bone graft, cut to fit the deep gutter, is anchored in place with chromic gut sutures drawn through drill holes.	(3) Bone graft instrument set, chromic gut sutures, cutting-edge needles, moist sponges, small pads, electric saw, drill impactor
6. Two small bone flaps are raised from each lamina.	6. Angled gouges and rongeurs
7. The spinous processes are split and broken down. All bone chips are saved, later to be placed in the wound, and may be transfixed with metal bone screw and plate.	7. Suction set, osteotomes, rongeur forceps, cup for bone chips, warm normal saline solution, bone screws and screw driver, wooden board, rongeur, scalpel
8. The entire periosteal sheath is brought together and sutured.	8. Chromic gut No. 1 or silk No. 2-0 or 1-0 threaded on curved Martin needle No. 6, tissue forceps, scissors
9. The fascial layer is closed.	9. Interrupted sutures, plain or chromic gut No. 0 or silk No. 2-0 threaded on curved Murphy needle No. 3
10. The skin edges are approximated, and dressings are applied to the wound. A brace or plaster jacket casing is frequently applied to immobilize the spine.	10. Silk No. 4-0, nylon No. 5-0, or wire No. 6-0 threaded on Keith needles, gauze compresses, cotton and bandage, desired brace or plaster cast setup

Herniated Intervertebral Disc Operation.—This operation is described in Chapter 6.

In the Hibbs operation the posterior neural arch is fused by overlapping numerous small osseous flaps from contiguous laminae, spinous processes, and articular facets. Modifications of these two techniques and one of several different types of grafts are now used.

Purpose.—*A spinal arthrodesis or fusion is done to treat a congenital,* traumatic, or degenerative lesion, or infective processes.[4, 5, 8]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as for spinal fusion. The patient is placed on a modern operating table in a prone position (Chapter 4). The operating table may be broken to elevate the superior spines and reduce strain on the abdominal and thoracic muscles and nerves, or a special table pad may be used. The proposed operative site is cleansed and surrounded by four sterile towels, which are held in place with towel forceps or sutures. If a graft is to be taken the affected leg is draped with sheets, as for a bone operation. A spinal fenestrated sheet is draped over the patient in such a manner that it does not cover the draped leg, which is then covered with a small sheet until the graft is to be taken.

Operative Procedure.—The steps and items, as shown in Figs. 489, 490, and 542, include the following:

Steps	*Items*
1. A midline incision is carried down to the underlying osseous prominences to be fused. Bleeding vessels are ligated.	1. Sponges, scalpel, tissue forceps, Crile hemostats, sutures—chromic gut No. 2-0 or silk No. 3-0, scissors
2 The surgical towels are applied to the skin edges. The wound edges are retracted.	2. Two towels, silk sutures on skin needles, or towel forceps, Roux retractors
3. The ligamentous and tendinous attachments to the bone are dissected. The soft tissues are dissected away from the bone. Bleeding vessels are controlled.	3. Hibbs retractors, scalpel, tissue forceps, moist sponges, small pads, sharp, broad periosteal elevators, raspatory, fusion pads, sponges, normal saline solution and Asepto syringe, ligatures, or electrosurgical machine
4. The tissues and muscles are retracted.	4. Self-retaining retractor, Hibbs retractors
Hibbs Method.—	
5a. (1) Cartilage is removed from the articular joints of the desired vertebras.	5a (1) Curved and straight curettes Nos 3-0 and 2-0, thin straight and angular osteotomes, mallet
(2) The superior and inferior borders of the laminae are split off and the bone fragments are fractured at their base. The osseous fragments from the laminae are interlaced	(2) Gouges, straight and angled, mallet, forceps, sponges, fusion pads, compressed cotton

Steps	*Items*
(3) The spinous processes are cut and shifted downward so that each process is in contact with a raw surface.	(3) Bacon rongeur, Ochsner forceps, pads, suction set, warm normal saline solution, Asepto syringe
(4) Free bone chips may be placed in the denuded articular process joints.	(4) Wooden board, scalpel, curette to remove tissue from the bony chips
(5) The bone chips may be transfixed with screws or plate and screws. Screws are sometimes transfixed through the articular facets.	(5) Bone screw insertion setup
Albee Method.—	
5b. (1) The supraspinous and interspinous ligaments are divided.	5b. (1) Retractors, scalpel, tissue forceps, scissors, gauze and compressed cotton, sponges
(2) The spinous processes are exposed and split and the bases of the spinous processes on one side are fractured, so that a gutter is formed.	(2) Bacon rongeurs, periosteal elevators and raspatories, mallet, gouges, chisels, osteotomes, sponges, fusion pads, suction set
(3) A full-thickness tibial bone graft, cut to fit the deep gutter, is anchored in place with chromic gut sutures drawn through drill holes.	(3) Bone graft instrument set, chromic gut sutures, cutting-edge needles, moist sponges, small pads, electric saw, drill impactor
6. Two small bone flaps are raised from each lamina.	6. Angled gouges and rongeurs
7. The spinous processes are split and broken down. All bone chips are saved, later to be placed in the wound, and may be transfixed with metal bone screw and plate.	7. Suction set, osteotomes, rongeur forceps, cup for bone chips, warm normal saline solution, bone screws and screw driver, wooden board, rongeur, scalpel
8. The entire periosteal sheath is brought together and sutured.	8. Chromic gut No. 1 or silk No. 2-0 or 1-0 threaded on curved Martin needle No. 6, tissue forceps, scissors
9. The fascial layer is closed.	9. Interrupted sutures, plain or chromic gut No. 0 or silk No. 2-0 threaded on curved Murphy needle No. 3
10. The skin edges are approximated, and dressings are applied to the wound. A brace or plaster jacket casing is frequently applied to immobilize the spine	10. Silk No 4-0, nylon No. 5-0, or wire No. 6-0 threaded on Keith needles, gauze compresses, cotton and bandage, desired brace or plaster cast setup

Herniated Intervertebral Disc Operation.—*This operation is described in* Chapter 6.

Arthrotomy of Knee Joint for Repair of Torn Cartilage (Menisci)

Definition.—The knee joint is exposed and explored through an anteromedian, paramedian, or oblique incision, and the torn meniscus is removed.

Considerations.—Rupture of the internal and external semilunar cartilages occurs frequently due to a twisting motion. The injury may cause the anterior or posterior horn to become detached from the upper tibia. Or the cartilage may split, allowing one portion to enter the central region of the knee joint and the other portion to remain in its normal position along the outer margin of the joint. (Figs. 513 and 514.)

Setup, Position, Skin Preparation, and Draping Procedure.—Open reduction setup, including cartilage osteotome, scalpel, tenotomy knives, and cotton elastic bandages. Routine skin preparation is done, and a leg draping procedure is carried out.

Operative Procedure.—The steps and items, as shown in Figs. 493 and 494, include the following:

1. An incision is made in the knee joint and carried through the subcutane-

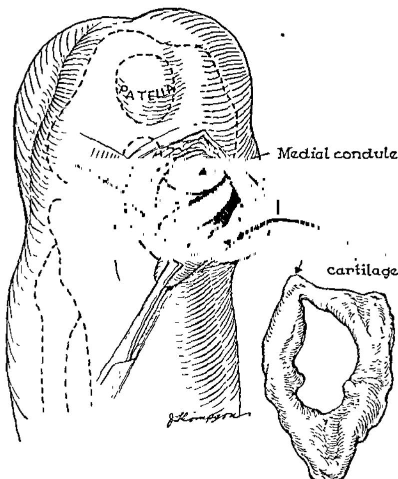


Fig 513.—Bucket handle tear of internal semilunar cartilage (From Richards, V.: Surgery for General Practice, St Louis, 1956, The C V Mosby Co)

ous tissue (Fig. 535). The wound edges are protected as described for internal fixation.

2. The capsule of the knee is opened and its edges are retracted; the synovial membrane is opened (Fig. 473*A* and 473*B*).

3. The medial and lateral menisci are identified, and the structures of the knee joint are examined, using elevators and retractors (Fig. 513). Broken cartilage and loose body or synovial tabs are removed, using Ochsner forceps, long knife, tenotomes, and tissue forceps (Fig. 514). The knee joint is irrigated, using an Asepto syringe filled with normal saline solution.

4. The synovial layer is closed with chromic gut No. 2-0 threaded on ½-circle trocar-point Murphy needle.

5. The wound is closed in layers and covered with dressings. The extremity is stabilized in a splint.

Osteotomy

Definition.—The diseased bone is cut through at the proper level, and sometimes a wedge is removed to produce a fracture under controlled condi-

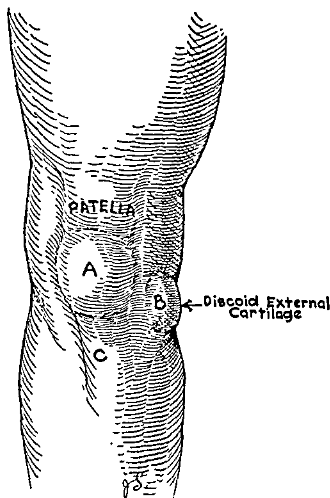


Fig 514—Discoid external cartilage. (From Richards, V
Louis, 1956, The C V. Mosby C

tions. The limb is immobilized in the desired position until union has taken place.

Considerations.—Osteotomy occasionally is done to treat joint instability which is causing pain, stress, and fatigue. It may also be done to reduce the malposition of an old fracture or to correct angular or rotary bone deformities which are due to the presence of rickets, Paget's disease, or a congenital malformation.[13, 21]

Purpose.—To change the alignment or shape of a bone.

Setup, Position, Skin Preparation, and Draping Procedure.—Osteotomy setup. The position of the patient on the operating table and the type of draping procedure to be carried out will depend upon the location of the operative site.

Operative Procedure.—The major steps include the following:

1. The skin incision is made over the site of the angulation and carried down to the affected bone.
2. The subperiosteum is removed from the bone by means of sharp periosteal elevators and a scalpel.
3. The proposed site for the osteotomy is drilled with holes. A hand drill or electric-driven drill may be used. A wedge of bone lying within the drill holes is removed with osteotomes and mallet and added to the operative site to provide for better alignment. It is fixed in place by means of a bone graft or a metal plate and screws, by placing bone chips around it.
4. The periosteum, muscle and fascia, and skin edges are closed in layers, and dressings are applied to the wound. The limb is encased in a plaster cast.

Bone Equalization, Bone Lengthening or Shortening

Definition.—Shortening a good leg by osteotomy, lengthening a leg by means of staples, or shortening the femur by means of osteotomy.[4, 8]

Setup, Position, Skin Preparation, and Draping Procedure.—As for osteotomy, skin preparation and leg draping procedure (Fig. 488).

Considerations and Operations.—A difference in the length of a leg is caused by a shortening of one side or by overgrowth of the opposite side. Such conditions result from epiphyseal injuries, poliomyelitis, congenital anomalies, and fractures of the femoral shaft (Fig 525).

Treatment usually consists of shortening the good leg by cylindrical resection, or preferably oblique osteotomy through the shaft of the femur. Leg lengthening procedures are considered to be very hazardous.

In children, epiphyseal growth may be prevented by means of staples which are applied across the epiphyseal line on each side of the leg above or below the knee (Fig. 488). When the staples are removed growth may continue if the epiphysis has not closed.

If femoral shortening is accomplished by osteotomy the fragments are permitted to overlap and long metal screws are inserted to maintain reduction. Internal fixation set and osteotomy setup are required.

Operations on Shoulder and Elbow

Recurrent Dislocation of the Shoulder Joint

Definition (Bankart Operation).—Through a deltopectoral incision the defect of the glenoid cavity is repaired.[9, 11, 15, 16] In some cases this procedure is

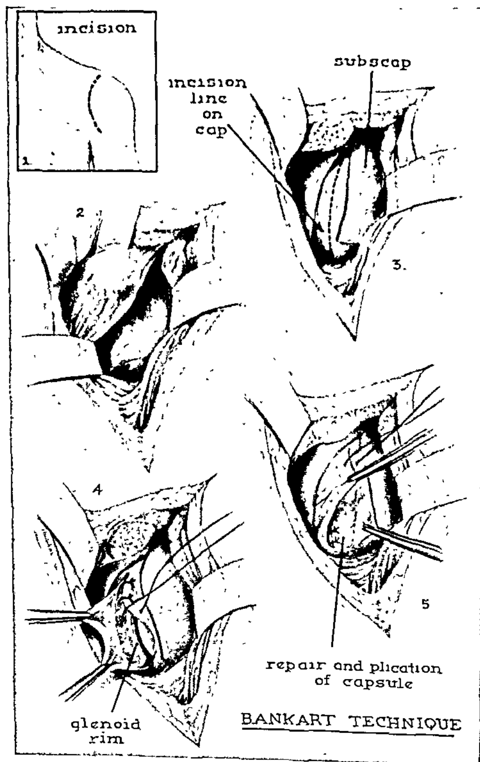


Fig 545.—Bankart technique for recurrent dislocation of shoulder. (From Bateman, L. E.: The Shoulder and Environs, St Louis, 1956, The C V. Mosby Co)

augmented by bringing together the capsule and the subscapularis muscle (Putti-Platt repair).

Considerations.—Traumatic anterior dislocation of the shoulder joint, even after treatment, may be followed by a recurrence (Figs. 470, 475 to 477). This injury occurs when the arm is abducted and the shoulder rotated too far, thereby pushing the head of the humerus out of the glenoid cavity (Fig. 511). This type of injury may cause a subglenoid, subcoracoid, or subspinous dislocation, depending on the intensity of the violence and the degree of abduction (Fig. 512).

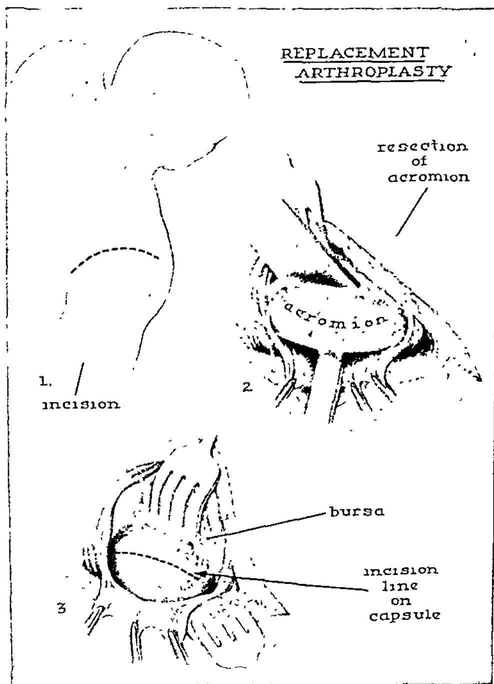


Fig 546.—Technique of replacement Arthroplasty of shoulder (From Bateman, L. E: The Shoulder and Environs, St Louis, 1956, The C V Mosby Co)

The muscles around the joint may be ruptured, and sometimes the nerves are injured sufficiently to cause a paralysis of the arm.

The Bankart, Magnuson, DePalma, and Nicola operations have been devised to treat recurrent dislocation of the shoulder (Fig. 545).

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for a shoulder joint operation, including narrow osteotomes, chisels, mallet, staples, bone drill and fine drill points, stainless steel wire, and chromic gut sutures.

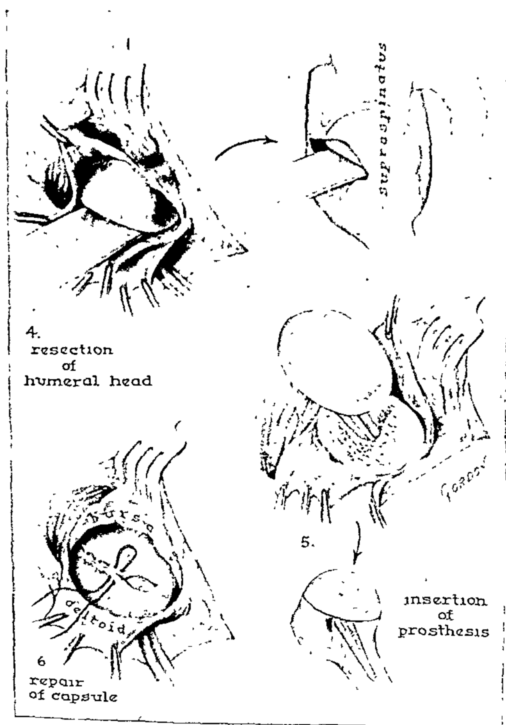


Fig. 546 (cont'd).—*For legend, see opposite page*

The patient is placed on the operating table in a supine position, with his affected side turned at a 45-degree angle toward the other side and supported by sandbags and padded braces. The table is tilted to provide a longitudinal operative site. Routine skin preparation and shoulder draping procedure are done as described previously.

Operative Procedure.—The major steps, as shown in Figs. 545 and 546, include the following:

1. A curved skin incision is made over the anterior aspect of the shoulder so that the distal end of the incision is over the deltopectoral groove.

2. The exposure is made between the deltoid and the pectoralis major muscles. The cephalic vein is ligated and retracted.



Fig 547.—Result of a recent arthroplasty (From Bateman, L. E.. The Shoulder and Environs, St Louis, 1956, The C. V. Mosby Co)

3 The coracoid process is divided by an osteotome and then pulled downward.

4 The tendon of the subscapularis muscle is exposed, clamped, and divided (Figs. 476 and 477).

5. The joint capsule and the glenoid ligament are reattached to the exposed bone either with sutures, which are inserted in drill holes with staples, or with pull-out wire sutures, as described for tendon repair. The redundant capsule is attached to the stabilized glenoid ligament and to the periosteum on the neck of the scapula

6. The subscapularis muscle is reattached to the lesser tuberosity and the coracoid process is reattached. The muscle, subcutaneous tissue, and skin are closed in layers.

7. Surgical dressings are applied to the wound. The shoulder is supported by applying a Velpeau's bandage with the arm positioned close to the chest and the elbow flexed at about a 40-degree angle.

Arthroplasty of the Shoulder

The setup and steps of the operation are similar to those as described for dislocation of the shoulder. Steps of operation are similar to those shown in Figs. 539, 540, 546, and 547.

Aspiration of the Elbow

The setup has been listed previously in this chapter, and the operative site is illustrated in Fig. 548.

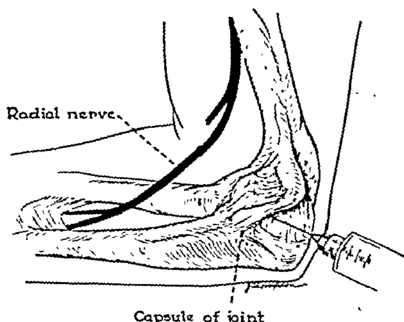


Fig. 548.—Aspiration of elbow joint behind and below external epicondyle. (From Richards, V.: Surgery for General Practice, St Louis, 1956, The C. V. Mosby Co)

Operations for Removal of Diseased Bone

Excision of Exostosis

Definition.—Removal of the bony protuberances about the tendon or muscle insertions on a bone.

Setup, Skin Preparation, Position, and Draping Procedure.—Basic setup for exostosis, including osteotomes, chisels, curettes, rongeurs, and mallet. Routine skin preparation is done. The position of the patient on the operating table and draping procedure carried out will depend upon the location of the proposed operative site.[4, 28]

Operative Procedure.—The steps and items include the following:

1. An incision is made over the prominence of the exostosis, using a scalpel, scissors, and tissue forceps.

2. The exostosis is dissected free and cut off at its base where it connects with the cortex of the normal bone, using heavy scissors, tenaculum, Ochsner forceps, chisels, elevator, osteotome, and mallet. The remaining bony surfaces are made smooth with a rongeur and file.

3. The fascial layer is closed with interrupted silk or chromic gut sutures Nos. 3-0 and 2-0, and the skin edges are approximated with fine wire, nylon, or silk. Surgical dressings are applied to the wound and secured by applying a gauze bandage.

Bunionectomy

Definition.—(1) The Mayo operation includes a partial excision of the head of the first metatarsal. (2) The Keller operation includes a resection of the proximal part of the first phalanx of the great toe (Fig. 472). (3) The McBride operation includes the attachment of the adductor muscles of the great toe to the shaft of the first metatarsal. (4) The Silver operation includes the excision of the exostosis, formation of a capsular flap, and insertion of sutures in the distal flap to adduct the great toe (Fig. 519).[3, 4]

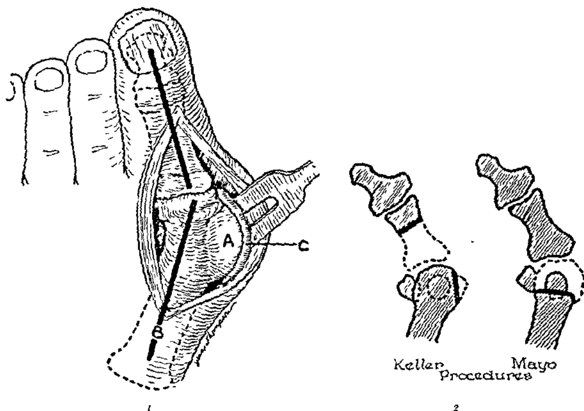


Fig. 519.—*1*, Bunion. *A*, Exostosis of metatarsal head; *B*, hallux valgus deformity; *C*, overlying bursa. *2*, Operations for hallux valgus. (From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co.)

Considerations.—Hallux valgus is the deviation of the great toe to the lateral side of the foot. When it is significant surgical treatment (arthroplasty) is necessary.

Purpose.—To remove the exostosis and restore function of the joint.

Setup, Position, Skin Preparation, and Draping Procedure.—As for arthroplasty of a small joint. The patient is placed on the operating table in a supine position. The skin area is cleansed, and foot draping procedure is carried out (Fig. 497).

Operative Procedure (Keller Operation).—A curved dorsal incision is made over the metatarsophalangeal joint on its medial side, and the bursa and exostosis are removed.[4, 7, 26]

Amputations

Definition.—A partial or total removal of an extremity.[47-49] Amputations may be classified in two main groups: the open and closed types.

The open type is a temporary amputation in which the surface of the wound is not covered with skin and the wound is left open to provide for adequate drainage and control of actual or potential infection. This method must be followed by a final repair.

The closed type of amputation is a final procedure in which ample skin and muscle flaps are used to create a stump so that a prosthesis can be worn effectively.[4, 48]

Considerations.—The major condition which demands amputation is a complete loss of blood supply to the extremity.[4] An amputation also may be done in the presence of a malignant tumor, uncontrolled infection, or an extreme congenital deformity resulting in complete loss of function.

Setup, Position, Skin Preparation, and Draping Procedure.—Setup for amputation. The kind and number of instruments, sutures, and sterile draping sheets to be used will depend on the location of the proposed amputation. The patient is placed on the operating table in a supine or lateral position. The affected joint is flexed and the extremity supported. The proposed operative site is prepared in the routine manner. The patient is draped with sterile sheets, and a tourniquet may be applied.

Operative Procedure (Closed Amputation on a Long Bone).—The steps and items, as shown in Figs. 491, 492, and 517, include the following:

1. Various types of skin flaps have been devised (Fig. 550). Generally the anterior flap is cut longer than the posterior one in a relation of three to two so that the scar will fall behind the bone rather than at the end.[47] The skin incision extends below the point of the saw line because the soft parts will retract. Bleeding vessels are clamped and ligated, using Crile hemostats and surgical gut sutures.
2. The muscles are divided. The major artery is dissected free from the surrounding tissue, doubly ligated, and divided.
3. The periosteum is divided by sharp dissection at the bone head.
4. The nerves are isolated and allowed to retract above the end of the bone. In some cases the nerves are infiltrated with 95 per cent alcohol or a 10 per cent solution of Novocain.
5. The skin and muscle flaps are retracted, using moist laparotomy pads and suitable retractors. The bone is divided with an electric saw or chisel, osteotome, and mallet The sharp and projecting bony prominences are removed and the surfaces smoothed, using rongeurs, bone-cutting forceps, and bone file. The bone dust is also removed by irrigating the wound with normal saline solution.

6. The tourniquet, if used, is removed and bleeding vessels are controlled with sutures. The fascial flaps are approximated with interrupted sutures of surgical chromic gut or silk No. 2-0 or 3-0. The skin flaps are approximated with fine nylon or stainless steel wire sutures No. 5-0 or 6-0.

7. A drain may be introduced in the wound to minimize the formation of a hematoma. The wound surface is covered with dry flat gauze sponges; then fluff gauze and sheet wadding are applied. The latter is held in place with a sterile elastic cotton or gauze compression bandage.

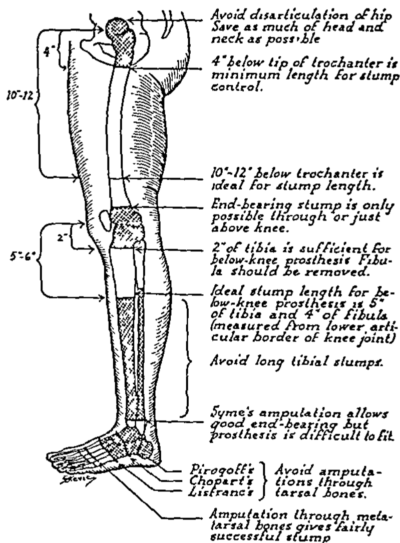


Fig 550 —Sites of election for lower extremity amputation. (From Compere, C L, and Thompson, R G: S Clin North America, Feb, 1957)

8. The patient is placed in his bed, with the stump elevated. Following a below-knee amputation, a plaster splint may be applied to ensure tissue rest and prevent flexion contractures of the knee (Fig. 517).

Operations for Repair of Tendon and Nerves of the Hand

Definition.—Suturing and fixation of a tendon, suturing of a nerve in the hand or wrist, or reconstruction of the bones, with or without tendon repair.

Purpose.—Because the hand depends for its function on the mobility of its small joints through proper balance and excursion of the tendons, surgery aims to preserve their smooth gliding surfaces in the sheath.[8, 18, 50-52]

Setup, Position, Skin Preparation, and Draping Procedure.—Setup as listed for tendon repair of hand. The patient is placed on the operating table in a supine position, with the affected arm extended and supported (Chapter 4). Routine skin preparation, application of a tourniquet, and draping procedure (Fig. 508) have been described previously.

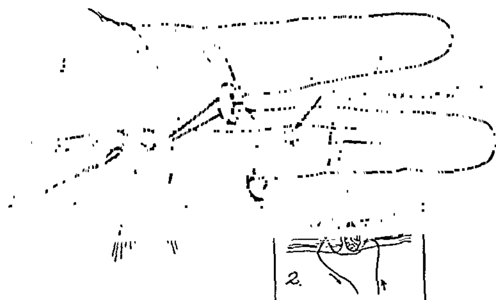


Fig 551—Bunnell method of tendon suture when tendon is severed in flexor sheath. (From Richards, V.: Surgery for General Practice, St Louis, 1956, The C. V. Mosby Co)

Operative Procedure.—

1. The original incision is opened and extended parallel to the flexion crease and midlateral to the joints.
2. *Suturing of a Tendon.*—The divided tendon ends are exposed proximally and distally, and coapted with either fine monafilament stainless steel wire or silk. The severed tendon ends may be sutured by one of several methods: (a) end-to-end union with permanent silk sutures; (b) end-to-end pull-out sutures (Bunnell); (c) Gig pull-out sutures (Bunnell); and (d) end-to-end pull-out sutures at a distance (Bunnell)[18] (Figs. 551 and 552.)

The Bunnell traction pull-out suture is most often used to ensure firm fixation at an insertion to bone or distal tendon stump. To prepare pull-out wire sutures cut stainless steel monafilament wires, size 34 or 35 gauge, 10 and 18 inches long. Twist closely the 10-inch length of wire, using skin hook and clamp Thread each end of the 18-inch length of wire with straight Bunnell needles of 3/8 fine curved needles, and twist the short ends tightly around the strand. Secure a curved needle in needle holder for passing pull-out wire through the skin. Hand a button to the operator for securing the ends of the pull-out wire.

After several weeks the button is clipped off and the pull-out wire is withdrawn (Fig. 551).

3. *Fixation of a Tendon to the Bone.*—The simplest method of tendon fixation consists of placing a suture in the end of the tendon by one of the techniques described previously. The bone cortex is elevated with an osteotome, and a drill hole is carried through to the opposite cortex. The two free ends of the wire suture which is fixed in the tendon are threaded on a straight Keith needle and passed through the hole in the bone and out on the skin on the opposite side. The free ends of the suture are threaded through a button. The tendon end is thus fixed in the bone tunnel.

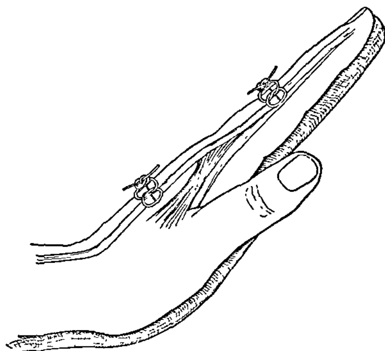


Fig 552—Repair of extensor tendon (after Bunnell) (From Richards, V: Surgery for General Practice, St Louis, 1956, The C V. Mosby Co)

Skin-Grafting Operations

Free Graft

Definition.—A free graft of skin is one of a given thickness and area which has been completely severed from its bed and transferred to another part of the body.

Considerations.—There are many classifications of free grafts, however, the two main types are the thin epidermal grafts and the full-thickness grafts including the dermis. The former is often called an Ollier-Thiersch graft and the latter, a Wolfe-Krause graft [6, 7]

Purpose.—To fill or cover the defect from loss of skin as soon as conditions are suitable, thereby preventing infection, fibrosis, and loss of muscle and joint functions.

Setup, Position, Skin Preparation, Draping Procedure.—Skin-grafting setup as listed previously. The patient is placed on the operating table in a position that will provide for exposure of the wound and the donor site. If the thigh is chosen as the donor site it should be supported with sandbags or pads and slightly abducted to flatten the iliotibial band. The knee should be slightly flexed to reduce prominence of the hamstrings. When the back or buttock is to be the donor site the patient is placed in a side-lying or face-down position (Chapter 9). The donor site is shaved and cleansed (Chapter 3). The patient is draped with sheets so that the wound and donor site are exposed.

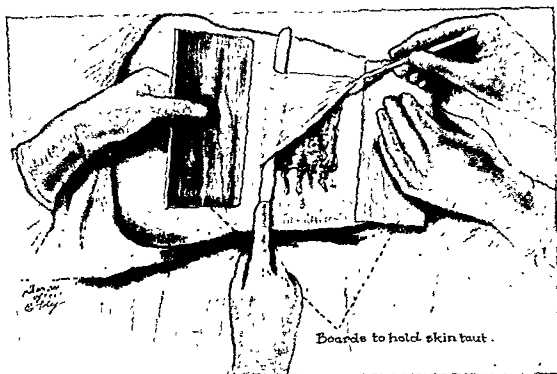


Fig 553.—Freehand cutting of skin graft Pinch and Davis grafts. (*From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co.*)

Operative Procedure.—The steps include the following:

1. The recipient area is prepared by removing excessive granulation tissue to provide a smooth vascular bed for the graft. Hemostasis is obtained by application of pressure, warm saline solution, and 1:5,000 solution of Adrenalin.

2. The dermatome is set at the desired thickness. The drum of the dermatome and the donor site are painted with a rubber cement, which is allowed to dry for four to five minutes or until its glossy look has disappeared. The leading edge of the drum is set and the skin removed by the appropriate technique. The drum is first pressed against the donor site, rotated, and the knife handle slid backward and forward to remove the skin, which is then severed with scissors. If the Brown electro-dermatome is used, glue, cement, or suction cups are not needed.

3. When a Ferris-Smith blade or other free-hand razor knife is used, the assistant maintains traction on the donor site, using two wooden boards, as

After several weeks the button is clipped off and the pull-out wire is withdrawn (Fig. 551).

3. *Fixation of a Tendon to the Bone.*—The simplest method of tendon fixation consists of placing a suture in the end of the tendon by one of the techniques described previously. The bone cortex is elevated with an osteotome, and a drill hole is carried through to the opposite cortex. The two free ends of the wire suture which is fixed in the tendon are threaded on a straight Keith needle and passed through the hole in the bone and out on the skin on the opposite side. The free ends of the suture are threaded through a button. The tendon end is thus fixed in the bone tunnel.

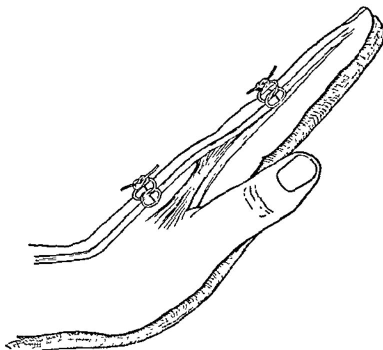


Fig 552 —Repair of extensor tendon (after Bunnell) (From Richards, V.: Surgery for General Practice, St Louis, 1956, The C V Mosby Co)

Skin-Grafting Operations

Free Graft

Definition.—A free graft of skin is one of a given thickness and area which has been completely severed from its bed and transferred to another part of the body.

Considerations.—There are many classifications of free grafts; however, the two main types are the thin epidermal grafts and the full-thickness grafts including the dermis. The former is often called an Ollier-Thiersch graft and the latter, a Wolfe-Krause graft.[6, 7]

Purpose.—To fill or cover the defect from loss of skin as soon as conditions are suitable, thereby preventing infection, fibrosis, and loss of muscle and joint functions.

3. The graft is positioned on the recipient site, and its surrounding edges are sutured to the adjacent edges of the graft with interrupted silk or nylon sutures No. 5-0 fused to cutting-edge needles.

4. The graft is held in place with a compression dressing, as described for a split-thickness graft. The donor site is dressed.

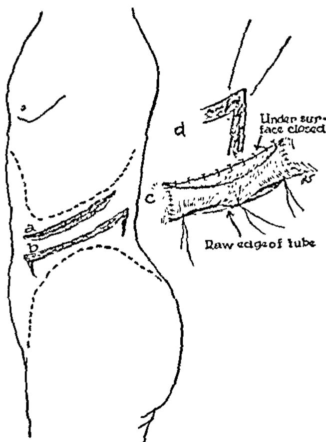


Fig 554—Tubed pedicle under construction (after Bunnell) (From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C. V Mosby Co)

Pedicle Skin Flap Operations

Considerations.—Full-thickness skin loss often requires replacement through the application of a pedicle skin flap, especially if vulnerable structures are exposed and/or if reconstructive surgery is required. These grafts of skin and subcutaneous fat prevent scar contracture, thereby minimizing deformity.

The donor site for a pedicle flap is determined by the part to be resurfaced. Full-thickness skin losses of the hand and forearm can be replaced easily with flaps from the abdominal wall. Intact skin can be rotated from an adjacent area to cover a defect or correct a contracture, when the demand is not too great. Rotation flaps find their greatest application in reconstructive surgery of the head and neck. Major soft tissue defects of the head and lower extremities can be resurfaced by tubed or "jump" pedicle flaps from the abdomen carried by way of an arm (Figs 554 and 555).

the operator shaves off the skin. In some situations a Blair suction box rather than the boards may be used. (Fig. 553.)

4. The skin graft is flattened out on a metal surface, moistened with saline solution, and transferred to the recipient area.

5. The graft is sutured in place with fine silk or nylon sutures swaged to fine curved skin needles.

6. Manual pressure is applied to the graft for several minutes, using gauze sponges.

7. A bulky (balus) dressing is used when immobilization of the graft is difficult. In such a case the individual sutures are left long and tied diametrically over the fluffed gauze.

8. Fine mesh, medicated gauze, fluffed gauze, and compression bandage are applied to provide a firm dressing.

9. The donor site is covered with fine mesh gauze, and a bandage is applied.

Small-Thickness Graft Operation

The patient is prepared as described for a free graft.

1. A cone of the skin on the donor site is elevated by piercing it with a straight needle secured to a clamp.

2. The apex of the skin's pyramid is cut off with a sharp knife or razor blade; then the skin on the needle is transferred to the raw area.

3. The donor site is covered with warm saline sponges to control bleeding vessels. The wound is covered with fine gauze saturated with an antiseptic ointment, and gauze dressings are applied. The recipient site is covered by a sterile pressure dressing.

Full-Thickness Graft Operation

(Wolfe-Krause)

Definition.—Transplantation of a full depth of skin, without any attached fat, from a donor site to the recipient site.

Purpose.—To resurface freshly opened wounds in the face, neck, hands, or small areas where the skin graft will be under pressure and wear.

Setup and Preparation of the Patient.—Skin-grafting setup. The position of the patient on the operating table will depend upon location of the sites to be selected. Routine skin preparation and draping procedures are carried out.

Operative Procedure.—The steps include the following:

1. The scar tissue on the recipient site is removed, and a pattern is made to outline the contour of the defect, using metal foil, rubber tissue, or paraffin gauze.

2. The pattern is placed over the donor site and the skin area is outlined with a sharp knife; then the desired skin is incised and its edges are grasped. The graft is then dissected free.

13. Luck, J. V.: Bone and Joint Diseases, Springfield, Ill., 1950, Charles C Thomas, Publisher.
14. Ingram, A. J., and Smith, H: Dislocations; in Walters, W. (ed.): Lewis' Practice of Surgery, Hagerstown, 1952, W. F. Prior Co., Inc., vol. 3, chap. 3.
15. Edwards, J. W.: Orthopedic Appliances Atlas, Ann Arbor, 1952, American Academy of Orthopedic Surgeons, vol. 1.
16 Banks, S. W., and Laufman, H.: An Atlas of Surgical Exposures of the Extremities, Philadelphia, 1953, W. B. Saunders Co.
17. Moseley, H. F.: An Atlas of Musculoskeletal Exposures, Philadelphia, 1955, J. B. Lippincott Co.
18 Bunnell, S: Surgery of the Hand, ed. 3, Philadelphia, 1955, J. B. Lippincott Co.
19 Campbell, E., and Whitefield, R.: Emergency Management of Injuries of Head and Spine, S Clin. North America 10:1295, 1956.
20. Crutchfield, W. A.: Skeletal Traction in the Treatment of Injuries to the Cervical Spine, J.A.M.A. 155:29, 1954.
21. Knight, R. A., and Smith, H: Injuries and Surgical Diseases of Joints; in Lewis, D. (ed): Practice of Surgery, Hagerstown, 1953, W. F. Prior Co., Inc., vol. 2, chap. 5.
22 Hampton, O. P., Jr.: Emergency Management of Major Injuries of Extremities, S. Clin. North America 10:1261, 1956
23. Key, J A, and Conwell, H. E.: The Management of Fractures, Dislocations, and Sprains, ed. 5, St. Louis, 1956, The C V. Mosby Co.
24. Lindsley, D: Early Care of the Injured (Symposium on Emergency Surgery of Trauma), S. Clin. North America 2:1191, 1956, and 2:269, 1957.
25. Mason, M. L., and Bell, J. L. The Treatment of Open Injuries of the Hand (Symposium on Emergency Surgery of Trauma), S. Clin. North America 2:1337, 1956.
26 Richards, V.: Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co.
27. Artiz, C P, and Howard, J. M.: Initial Care of Severely Wounded, J.A M.A. 156:488, 1954.
28 Hampton, O P., Jr.: The Prevention of Gas Gangrene and Tetanus, Indust. Med. 23:309, 1954.
29 Shafer, S J. The Management of Non-Union of the Shafts of the Long Bones, S. Clin. North America 2 223, 1957.
30 Armstrong, J R.. Bone Grafting in the Treatment of Fractures, Baltimore, 1945, Williams & Wilkins Co.
31 Bohler, L.: The Treatment of Fractures, ed 5, New York, 1956, Grune & Stratton, Inc., vol. 3.
32 Hark, F. W. Rehabilitation of the Infantile Paralysis Patient, S. Clin North America 2:1261, 1956.
33 Compere, E L, Banks, S W., and Compere, C. L.: Pictorial Handbook of Fracture Treatment, ed 3, Chicago, 1952, Year Book Publishers, Inc.
34 Scuderi, C. Atlas of Orthopedic Traction Procedures, St. Louis, 1954, The C. V. Mosby Co.
35 Blount, W. P Fractures in Children, Baltimore, 1954, Williams & Wilkins Co.
36 Campbell, R D, Jr, and Wade, P. A: Open Versus Closed Methods of Treatment of Fractures of the Leg (Reviewed 287 Cases), Am. J Surg., April, 1958.
37 Bohler, L. Medullary Nailing of Kuntscher, German ed. 11, Thetter, H. (Trans), Baltimore, 1948, Williams & Wilkins Co.
38 Eggers, W N Internal Fixation of Fractures of the Shaft of Long Bones, Monographs in Surgery, New York, 1952, Thomas Nelson & Sons
39 Lottes, J O Blind Nailing Technique for Insertion of the Triflange Medullary Nail, J A M A. 155:1039, 1954.
40 Neufeld, A J, and Taylor, G M.: Internal Fixation for Intertrochanteric Fractures, J. Bone & Joint Surg 26:707, 1944.
41 Petersen, L T Principles of Internal Fixation With Plates and Screws, A M.A. Arch. Surg. 64.345, 1952.
42 Smith, H: Medullary Fixation of the Femur, Radiology 61:195, 1953.
43 Judet, J. and others Resection-Reconstruction of the Hip, Baltimore, 1954, Williams & Wilkins Co

In all transfers of full-thickness skin and subcutaneous tissue, an adequate arterial and venous circuit must be maintained for survival. Extreme care must be taken in the designing and transferring of pedicle skin flaps to ensure the flap from being under too great tension and to keep its pedicle free from circulatory jeopardy.

Pedicle flaps require full immobilization, especially for the extremities. Approximately three to four weeks are required for the transformed portion of the pedicle flap to develop an adequate circulation from the recipient area.

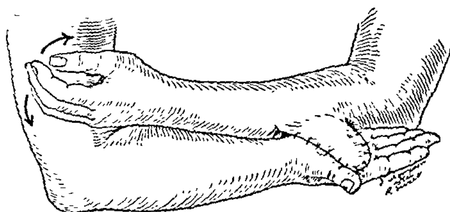


Fig 555.—The open jump pedicle graft. (From Richards, V: Surgery for General Practice, St Louis, 1956, The C V. Mosby Co)

The donor attachment may be totally or partially divided (delayed) at this time, depending upon the amount of tissue to be transferred. Pedicle flaps depend at all times upon a blood supply, at first from the donor attachment and finally from that of the recipient. A free skin graft is often required to cover the area from which a flap has been taken.

REFERENCES

1. Francis, C C Introduction to Human Anatomy, ed 2, St Louis, 1954, The C V. Mosby Co.
2. Adams, J C. Outline of Orthopaedics, Baltimore, 1956, Williams & Wilkins Co.
3. Watson-Jones, Sir Reginald Fractures and Joint Injuries, ed 4, Baltimore, 1955, Williams & Wilkins Co.
4. Speed, J S, and Knight, R A Campbell's Operative Orthopaedics, ed. 3, St Louis, 1956, The C V Mosby Co
5. Shands, A R, Jr Handbook of Orthopaedic Surgery, ed 4, St. Louis, 1957, The C. V. Mosby Co.
6. Ochsner, A, DeBakey, M E, and others Christopher's Minor Surgery, ed. 7, Philadelphia, 1955, W B Saunders Co, chaps 11, 12
7. Moseley, H F: Textbook of Surgery, ed 2, St Louis, 1955, The C V. Mosby Co.
8. Howorth, M B Textbook of Orthopedics, Philadelphia, 1952, W. B. Saunders Co
9. Bateman, J E. The Shoulder and Environs, St Louis, 1956, The C. V Mosby Co.
10. Lewin, P The Knee, Philadelphia, 1952, Lea & Febiger
11. DePalma, A F: Surgery of the Shoulder Philadelphia, 1950, J B Lippincott Co
12. Venable, C S, and Stuck, W G The Internal Fixation of Fractures, Springfield, Ill, 1947, Charles C Thomas, Publisher

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Asterisk (*) indicates page with illustration

44. Judet, J., and Judet, R.: Technique and Results With Acrylic Femoral Head Prosthesis, J. Bone & Joint Surg. 34:173, 1952.
45. Nicola, T.: Recurrent Dislocation of the Shoulder, Am. J. Surg. 86:85, 1951.
46 Scuderi, C: Fracture-Dislocations of the Shoulder (Diagnosis, Surgical, Pathology, and Treatment), S Clin. North America 2:169, 1957.
47 Slocum, D. B.: Atlas of Amputations, St. Louis, 1919, The C. V. Mosby Co
48 Slocum, D B.: Major Amputations, GP 3:55, 1951.
49 Compere, C. L., and Thompson, R. G.: Syllabus, Prosthesis Education Program, Los Angeles, 1956, University of California Press, Inc.
50. Littler, J. W.: Treatment of Hand and Wrist Injuries; in Howorth, M. B. (ed.): *Textbook of Orthopedics, Philadelphia, 1952, W. B. Saunders Co, chap. 9.*
51. Foman, S.: Grafts and Flaps in Otolaryngology, Hagerstown, 1955, W. F. Prior Co, Inc, vol. 3, chap 26, p. 313.
52. Littler, J. W.: Principles of Reconstructive Surgery of the Hand, Am. J. Surg. 92:88, 1956.

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